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Table of Contents

FEBRUARY, 1933

The Journal

Some Effects of Grain Size of China Clays—Vieweg 77
A Simple Dispersion Test for Clays—Wilson and Page 82
Some Notes on the Nature of Clay, II—Norton 86
Elimination of Blistering of Enameled-Iron Number Plates—Scott 93
Graphite as a Refractory—Stone 96
Constitution and Thermal Expansion of Silica Coke-Oven Brick after Service—Austin and Pierce, Jr 102
Effect of Various Gaseous Atmospheres on the Vitrification of Ceramic Bodies—Badger 107
Modern Waste-Heat Tunnel Driers—Garve 118

Ceramic Abstracts

41

The Bulletin

Editorials

Presidential Address, 1933—Poste 41
A Prophesy That Failed 48

Activities of the Society

Buy American—Dramatic Exhibits in Pittsburgh, Week of February 12 50
John Clyde Hostetter 50
Balance Sheet of The American Ceramic Society 52
Charles Fergus Binns Metal 55

Local Section News:

Baltimore-Washington Section 55
Pittsburgh Section 55

Necrology

L. E. Jeffery 55
Robert F. Segsworth 55
Edmund D. Otstot 55

Notes and News

New Director of the Bureau of Standards 56
Nelson W. Taylor Appointed Professor of Ceramics at Pennsylvania State College 56
J. E. Lewis Honored 57
Standard Classification of Feldspar—Burgess 57
Division Nominations 58

Advertiser's Index 13

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SOME EFFECTS OF GRAIN SIZE OF CHINA CLAYS*

By Hermann F. Viewег

ABSTRACT

Measurements of grain size of a series of china clays were made, and a preliminary investigation of the relation between particle size and some properties was undertaken.

I. Introduction

The terms "fine grained" and "coarse grained," as applied to china clays, seem to be in rather common use without a clear understanding as to what range of grain sizes is comprised in the field of commercially important clays, and what constitutes a "fine" or a "coarse" clay. It has been the object of this study to ascertain the general range of average particle diameters in a series of china clays, and to suggest a classification on the basis of relative fineness. With this objective, a series of twenty-two clays, consisting of a group of representative English china clays and American kaolins, was subjected to careful measurement of average particle size. A preliminary study was also made of some of the properties of these clays to ascertain whether a correlation of grain size with other properties was possible.

II. Procedure

Of the various means available for the estimation of grain size and size distribution, it was decided to make use of direct measurement from representative photomicrographs, because this method makes possible a reasonably accurate determination of sizes and shapes, and also provides a permanent record of the phenomena observed.

A standard procedure, which was in accord with regular practice, was adopted in the preparation of the specimens, their photographing, and measuring the photographic prints. A minute quantity of the material was taken up on a small spatula made from a platinum wire flattened at one end, and was placed on a microscope slide. A drop of oil (index of refraction = 1.445) was placed on a cover glass, which was then inverted over the sample. By rotating the cover glass by means of a soft rubber eraser placed in contact with it, it was possible to disperse the substance to be photographed thoroughly and uniformly. By inspection with the microscope at stages of this process it was determined whether dispersion had been completed and whether it was uniform. Occasionally it was necessary to prepare more than one slide before satisfactory results were obtained, but they were effected in every case without excessive effort. By careful inspection of the slide a representative field could be selected, due precautions being observed to avoid the erratic presence of any grains of larger than normal size which might cause misleading observations to be made. A photograph was taken only after thorough exploration of the entire slide, and deliberate choice of a field that was truly characteristic.

All photomicrographs were taken at a magnification of 500×. Cut film, with a process emulsion, was chosen after considerable experimentation as most suitable for the purpose.

Note: The use of cut film eliminates the danger of breakage and scratching which is encountered with plates and also offers the advantage of greater ease of handling

* Presented at the Annual Meeting, American Ceramic Society, Washington, D. C., February, 1932 (White Wares Division). Received September 27, 1932.

and storage. The process emulsion, although sacrificing much of the detail which is presented by orthochromatic film, reveals the grain boundaries in sharp contrast, making measurements less difficult. The difference in the type of photograph obtained may be seen by comparing Figs. 1 to 4, inclusive, which were prepared with process film, with Fig. 5, which is included here to show the results obtainable with commercial ortho film. Contact prints were prepared from the films.

Direct measurements of particle diameters were made by means of a transparent scale, which had been prepared by photographing a micrometer scale, consisting of a series of parallel lines at 10 microns interval, on a cut film of the same kind as was used throughout the work. In this manner a transparent, unbreakable scale of identical magnification with that of the prints was provided, making possible direct determinations of the dimensions of the clay particles.

Following the procedure outlined above, determination was made of the average particle diameter of each of the clays being investigated.

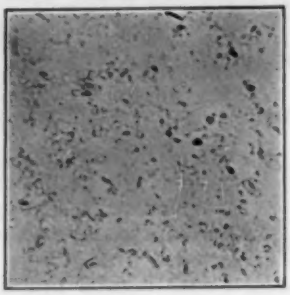

FIG. 1.—Photomicrograph of Clay No. 22 (magnification 500×, process cut film).

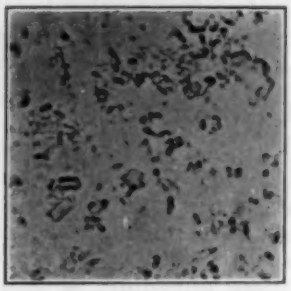

FIG. 2.—Photomicrograph of Clay No. 5 (magnification 500×, process cut film).

Of the many possible ways of obtaining an average, it seemed that the calculation of the value of $\frac{\Sigma d^3}{\Sigma d^2}$ (an expression which makes the specific surface the basis of comparison) was the most suitable one. This is in agreement with the suggestion of Perrott and Kinney[1] and the usage adopted by Roller.[2] Evaluation of the particle size involved the measurement and subsequent calculation of a large number of grains in each case, sometimes hundreds, the number depending on the size and uniformity of size. The larger the size, the fewer there will be in a photograph of a certain area, but this is offset by the fact that individual measurements will be more accurate. The more uniform the size, the fewer will be the number of measurements necessary to give a reliable average.

In investigating the relation between grain size and other properties, ten 1- by 1- by 3-inch test bars were made up for each of the clays. After the drying shrinkage had been measured, the specimens were fired to cone 11 in approximately ten hours. The porosity of the fired specimens and the firing shrinkage were determined in each case. Standard practice was followed in making each of these determinations.

[1] Perrott and Kinney, *Jour. Amer. Ceram. Soc.*, **6**, 438 (1923).
[2] Roller, Bur. Mines, *Tech. Paper*, No. 490 (1931).

III. Results

(1) Grain Size The diameters of the microscopically discernible particles of the series of 22 clays investigated were found to vary from a minimum of about 0.5 micron to a maximum of 74 microns. The average diameter for the individual clays varied from 1.5 to 38 microns. Figures 1 to 5 indicate the range from the finest to the coarsest materials studied. (The reason for the difference in appearance between Fig. 5 and the others has already been given.) The individual results are recorded in column 2 of Table I.

FIG. 3.—Photomicrograph of Clay No. 13 (magnification 500×, process cut film).

(2) Other Properties The per cent linear drying shrinkage (an average of ten determinations in each case), the per cent linear firing shrinkage (an average of five determinations for each clay), and the per cent porosity (averaging three determinations) are listed in columns 3, 4, and 5, respectively, of Table I.

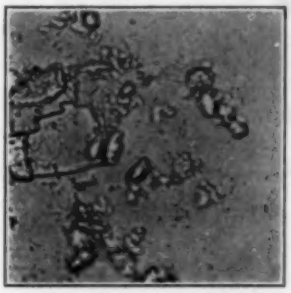

FIG. 4.—Photomicrograph of Clay No. 16 (magnification 500×, process cut film).

IV. Discussion and Conclusions

It is interesting to note the great range of particle diameters observable in a series of clays such as this. The ratio of the mass of a grain (of the size of the largest shown in Fig. 5) to that of the smallest in Fig. 1 is probably as much as 1,000,000 to 1. It should be pointed out that in making the determinations reported here, the fact that there are particles so small as to be invisible under the microscope was overlooked. It was felt, however, that the mass of such material was not great. To get further information on this point, use was made of the air separator kindly made available by P. S. Roller[3] of the U. S. Bureau of Mines Station at Rutgers University. Although it is impossible to determine directly the amount of material below 0.5 micron in diameter, experiments made on two of the finer clays, Nos. 19 and 5, showed that at most it could not exceed a few per cent. It is therefore felt that the average diameters determined from microscopic observation are reasonably indicative of the degree of subdivision of the clays investigated.

FIG. 5.—Photomicrograph of Clay No. 18 (magnification 500×, commercial ortho cut film).

Examination of the data shows that approximately half of the clays lie in the range of 7 to 15 microns. This fact suggests that clays which

[3] See footnote No. 2.

have average particle diameters between these limits, as determined by the method described in this paper, might be considered as average or medium. On the same basis those finer than 7 microns might be classed as fine, while all coarser than 15 could be considered as coarse.

In comparing these results with those attained by other investigators and by other methods, it is found that in general the kaolins which have been studied have grain sizes lying in the low or medium range. Thus Schurecht[4] determined by elutriation the surface factors for a diversified group of 18 kaolins which, when calculated as average grain sizes, ranged from 3 to 17 microns. Some of his specimens, however, must have been unwashed kaolins as, for example, one which had 51% coarser than 200-mesh. Weigel[5] found the average diameters of 11 clays to range from

TABLE I

GRAIN SIZE AND OTHER PROPERTIES OF CHINA CLAYS

Clay No.	Average particle diameter (microns)	Linear drying shrinkage (%)	Linear firing shrinkage (%)	Apparent porosity (%)
1	7	4.6	12.9	29.2
2	9	5.2	10.6	31.0
3	8	6.2	13.3	29.9
4	6	5.9	10.1	27.5
5	2	6.6	13.6	21.1
6	4	6.4	11.8	26.5
7	11	5.2	10.7	31.4
8	16	6.2	9.7	33.5
9	5	5.8	11.7	26.1
10	3	8.3	15.0	23.1
11	20	6.0	10.1	34.1
12	25	5.1	9.1	37.4
13	10	6.1	8.9	30.0
14	8	5.1	11.4	29.2
15	8	7.2	12.1	28.3
16	20	6.6	10.3	35.6
17	15	8.2	12.0	32.4
18	38	7.1	6.5	39.6
19	7	9.6	14.0	27.8
20	7	6.3	12.6	29.5
21	18	5.6	9.1	33.6
22	1.5	6.5	11.7	39.1

2.9 to 6.4 microns, as determined microscopically, and from 2.6 to 6.4 microns by elutriation methods. Schramm and Scripture,[6] in sedimentation experiments on 11 clays, found the percentages of material finer than 1.7 microns to range from 36.6 to 79.2 microns. These results would place all their clays in the fine group. Stark[7] found the mean grain diameter of seven kaolins to vary from 3.6 to 8.3 microns, using sedimentation methods.

These investigators do not claim to have made an effort to cover the whole range of grain sizes of kaolins; in general, they were interested in

[4] Schurecht, *Jour. Amer. Ceram. Soc.*, **3**, 355 (1920).
[5] Weigel, Bur. Mines, *Tech. Paper*, No. 296 (1924).
[6] Schramm and Scripture, *Jour. Amer. Ceram. Soc.*, **8**, 243 (1925).
[7] Stark, Die Physikalisch-Technische Untersuchung Keramischer Kaoline, Leipzig (1922).

making studies of methods of measurement, and the clays they used were fine because they were desirous of testing their methods on fine materials.

In this investigation a definite effort was made to include as large a range as possible, kaolins which were generally considered as very coarse having been included as well as those that were extremely fine. It was to be expected, therefore, that some of the results would be higher than those previously reported. The fine range, however, agrees well with what has been previously done.

Considering the matter of the relation of grain size to properties, it is found that the porosity of the fired specimens varies directly with the particle diameter. This is illustrated in Fig. 6, a curve in which the average particle diameter in microns is plotted against the apparent porosity in per cent. With one exception (clay No. 22), the points plotted fall within reasonable proximity of a smooth curve. The general trend of increasing porosity with increasing coarseness is thus clearly indicated. Similarly in the case of firing shrinkage there is a definite indication that the coarser the clay the lower the shrinkage. Those clays which would be classified as fine, as suggested above, showed firing shrinkages ranging from 15 to 10.1%, the medium group from 14.0 to 8.9%, and the coarse ones from 10.3 to 6.5%. As far as the drying shrinkage is concerned, it appears to be either independent of the grain size or considerably more dependent on some other factor. Although all other factors, including the chemical and mineralogical composition, were approximately constant, slight variations which could not be avoided undoubtedly produced more or less appreciable effects on the properties measured.

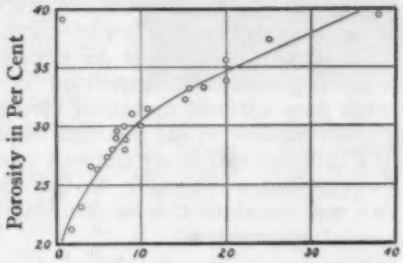

FIG. 6.—Relation between average particle diameter and per cent porosity of fired clay.

Acknowledgments The writer wishes to thank G. H. Brown for having suggested this investigation, and for his interest in the problem during its progress. The physical properties of the clays were determined by Lane Mitchell, to whom thanks are also due.

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A SIMPLE DISPERSION TEST FOR CLAYS*

By Hewitt Wilson[1] and George A. Page[2]

ABSTRACT

A test method was devised to indicate the comparative degree of dispersion of dry clay by simple blunging and removal of particles finer than 325-mesh. Tests of seven kaolins and one ball clay are given.

I. Introduction

There is a need for a standard dispersion test for clays used in the paper, whiteware, and other industries where clays are dispersed in water by blunging, stirring, beating, or any form of mechanical agitation other than grinding. Such a test likewise would give an indication of the general plastic and dry properties of clays.

The slaking test of the American Ceramic Society[3] is not adequate for measuring complete dispersion or blunging, because (1) the particles which pass without agitation through a $2^1/_2$-mesh sieve may not be dispersed completely, (2) the time required is too long for very plastic clays, (3) duplicate results are difficult to obtain, particularly since small masses of clay often will remain on the coarse wires for a long time, and (4) it does not simulate the mechanical blunging or churning action of commercial operations.

II. Locally Adopted Dispersion Method

After preliminary experiments with hand dispersion, mechanical agitation for a varying number of revolutions, and with different-sized test pieces, the following method was adopted for local standard procedure:

(1) Local Standard Method for Dispersion Test

(a) Test Pieces The test pieces shall be approximately $1^1/_8$ by $1^1/_8$ by $1^7/_8$ inches, prepared and dried in the manner specified by the American Ceramic Society in the standard method for drying shrinkage and water of plasticity.[4]

(b) Dry Weight The dried test pieces shall be cooled to room temperature in a desiccator and then shall be weighed with an accuracy of 0.1 gram. The dry weight of the individual test pieces shall not be less than 47.5 grams nor greater than 52.5 grams.

(c) Dispersion Two of the test pieces whose combined weight shall lie therefore between 95 and 105 grams shall be placed immediately with seven times their weight of water in a quart Mason jar and rotated in an end-over-end manner for 1000 revolutions at 40 revolutions per minute in a suitable revolving frame, equipped with a revolution counter (see Fig. 1).

(d) Water The temperature of the water at the beginning of the test shall not be lower than 20°C nor higher than 25°C.

---

* For the Annual Meeting, American Ceramic Society, Pittsburgh, Pa., February, 1933. Received November 7, 1932.

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[1] Nonmetallics Engineer, Northwest Experiment Station, U. S. Bureau of Mines, Seattle, Washington.

[2] Research fellow, University of Washington, 1931–1932.

[3] Standard Method for Slaking Test, *Jour. Amer. Ceram. Soc.*, **11** [6], 448–49 (1928).

[4] Standard Method for Drying Shrinkage, *ibid.*, pp. 450–51.

It shall either be freshly distilled water or tap water having a p_H value between 6.5 and 7.5.

(e) Jars The jars shall be the ordinary quart Mason jars, whose level-full capacity shall be 950 to 960 cubic centimeters, equipped with a rubber gasket and a tight-fitting lid.

(f) Screening Immediately after dispersion the contents of the jar shall be poured carefully onto a 325-mesh sieve immersed for one-quarter inch in clean water in a pan. Not more than 50 cubic centimeters of clean water shall be used in removing the last traces of clay from the quart jar. While the contents of the jar are being poured on the sieve, it shall be agitated in the water and tapped lightly on the upper rim to distribute the coarse particles over the screen and permit the dispersed fines to pass through the meshes when withdrawn.

FIG. 1.—Dispersion apparatus, consisting of an ordinary pebble-mill frame with an auxiliary wooden-base support for Mason jars, and a revolution counter.

(g) Drying the Residue The residue shall be removed from the sieve by means of a stream of water from a wash bottle to a suitable pan in which it shall be dried to constant weight at 110°C. Clear water left by coagulation and settling of the clay may be removed by a pipette.

(h) Per Cent Dispersion The dispersion, *i.e.*, the amount of material passing the screen, shall be calculated as a percentage of the weight of the two dry clay bars by the following formula:

$$D = \frac{W_d - W_r}{W_d} \times 100$$

in which

D = per cent dispersion
W_d = weight of the two original dried test pieces

and

W_r = weight of dried residue

(i) Variation A variation of ±15% from the average dispersion number is permissible. Tests showing a greater variation shall be considered faulty and discarded.

(j) Report The average of five test values shall be reported as the per cent dispersion.

(2) Supplementary Test Method If the degree of dispersion of clay as mined, shipped, or received at the factory is desired, the following changes in the foregoing method are suggested:

(a) Take 100 grams of the clay which has been dried to constant weight at 110°C and proceed in the same manner, without molding test bars, as that described in the local standard test. The report should include details of the preparation and the size of the particles in the test samples. Such a procedure shall not be considered as the standard method for per cent dispersion.

III. Laboratory Tests

The above standard method was used for seven china clays and one ball clay. The results are given in Table I.

TABLE I

DISPERSION TESTS OF REPRESENTATIVE CLAYS

North Carolina kaolin

Dispersion (%)	Deviation from average (%) Actual	Average
78.5	1.4	1.8
79.9	2.8	3.6
76.1	1.0	1.3
77.1	0.0	0.0
75.6	1.5	1.9
76.1	1.0	1.3
76.4	0.7	0.9
78.4	1.3	1.7
76.1	1.0	1.3
77.9	0.8	1.0
76.9	0.2	0.3
75.8	1.3	1.7

Average dispersion, 77.1%.
Average deviation, 1.4%.

Troy, Idaho, kaolin

Dispersion (%)	Deviation from average (%) Actual	Average
74.6	0.2	0.3
74.6	0.2	0.3
74.4	0.0	0.0
73.3	1.1	1.5
70.9	3.5	4.7
72.9	1.5	2.0
75.0	0.6	0.8
74.4	0.0	0.0
78.8	4.4	5.9
71.1	3.3	4.4
78.4	4.0	5.4
74.2	0.2	2.7

Average dispersion, 74.4%.
Average deviation, 2.3%.

English china clay

73.3	0.8	1.1
73.3	0.8	1.1
72.1	0.4	0.5
70.7	1.8	2.5
71.5	1.0	1.4
73.8	1.3	1.8
73.2	0.7	1.0
72.1	0.4	0.5

Average dispersion, 72.5%.
Average deviation, 1.2%.

Georgia kaolin

64.7	0.0	0.0
68.3	3.6	5.7
57.8	6.9	10.7
60.9	3.8	5.8
56.5	8.2	12.7
63.6	1.1	1.7
67.8	3.1	4.8
68.7	4.0	6.2
65.3	0.6	0.9
69.1	4.4	6.8
68.8	4.1	6.3
64.3	0.4	0.6

Average dispersion, 64.7%.
Average deviation, 5.2%.

Mica, Washington, kaolin

Dispersion (%)	Deviation from average (%) Actual	Average
48.0	4.6	8.8
53.6	1.0	1.9
59.5	6.9	13.1
48.3	4.3	8.2
51.1	1.5	2.9
53.4	0.8	1.5
50.2	2.4	4.6
56.4	3.8	7.2

Average dispersion, 52.6%.
Average deviation, 6.2%.

Moscow, Idaho, kaolin

Dispersion (%)	Deviation from average (%) Actual	Average
40.7	1.6	3.8
44.5	2.2	5.2
41.2	1.1	2.6
40.3	2.0	4.7
41.4	0.9	2.1
43.2	0.9	2.1
40.3	2.0	4.7
47.1	4.8	11.3

Average dispersion, 42.3%.
Average deviation, 4.6%.

English ball clay			Florida kaolin		
15.5*	4.3		22.4	2.3	11.5
21.4	1.6	8.1	19.8	0.3	1.5
20.6	0.8	4.0	20.2	0.1	0.5
21.0	1.2	6.1	18.9	1.2	6.0
15.5*	4.3		19.6	0.5	2.5
18.9	0.9	4.6	19.3	0.8	4.0
19.8	0.0	0.0			
17.2	2.6	13.1	Average dispersion, 20.1%.		
19.8	0.0	0.0	Average deviation, 4.3%.		

First average dispersion, 18.9%.
Corrected average dispersion, 19.8%.
Average deviation, 5.1%.

* Discarded.

IV. Accuracy

The accuracy and correlation of data obtained by different observers will depend upon the care used in molding and drying the test pieces and the manipulation used in removing the sample from the jar, together with the screening of the dispersed particles. Very plastic clays with low dispersion, with a tendency to entrap air during tempering and molding, or clays with a poor resistance to cracking will give discordant results. It was necessary to apply only the 15% permissible variation rule in the case of the English ball clay where the low per cent dispersion multiplied the actual deviation values by five to obtain the per cent deviations. The elimination of the discordant data, however, produced only 0.9% change in the dispersion value.

V. Conclusion

This test gives a comparative indication of the disruptive, penetrating effect of water into the dried, clay mass to reduce the grains to sizes finer than 325-mesh. The values obtained are likewise a rough inverse gage of that elusive property called plasticity.

Acknowledgment The work described in this report was conducted at the Northwest Experiment Station of the U. S. Bureau of Mines in coöperation with the University of Washington. The authors wish to acknowledge the assistance of Kenneth G. Skinner, research fellow, University of Washington, in checking the results for several clays.

SOME NOTES ON THE NATURE OF CLAY, II*

By F. H. Norton

ABSTRACT

The drying shrinkage curves were accurately determined for a number of clays and other finely divided substances. Some clays show a secondary shrinkage and others do not. The latter are generally the less plastic ones. Other finely divided materials beside clay may show considerable plasticity, *e.g.*, ferric oxide. The shrinkage curves give an insight into the nature of the surface film on the clay particles.

I. Purpose

The purpose of this investigation was the precise determination of the drying shrinkage curves for a number of clays and other finely ground materials. From the characteristics of these curves it was hoped to build up a picture of the fine structure of the clay and also, by a study of a considerable number of substances, to define the attributes of a plastic material more closely than at present.

TABLE I

Symbol	Name	Source and Preparation
A	Dark English ball clay	Blunged and screened through 100-mesh
B	Fine third of same	Blunged and deflocculated in a dilute slip and allowed to settle; portion in suspension
C	Medium third of same	Same treatment, but last settlings
D	Coarse third of same	Same treatment, but first settlings
E	Bentonite	American Colloid Co.
F	Red firing brick clay	Chelsea, Mass., Parry Brick Co.
G	Kentucky ball clay "D"	Old Hickory Clay & Talc Co., Hickory, Ky.
H	Sagger ball clay "A + B"	Old Hickory Clay & Talc Co., Hickory, Ky.
I	Gibbsite	$Al_2O_3 \cdot 3H_2O$ Dutch Guiana; hard lumps ball-milled; 100 hours wet
J	Florida plastic kaolin	Washed clay; Edgar Plastic Kaolin Co.
K	Dean flint clay	Dean, Pa., Harbison-Walker Refractories Co.; ball-milled 24 hours wet
L	Ocherous clay	Bennington, Vt.
M	D. E. ball clay + 50% flint	Potters flint added to the clay
N	No. 1 English china clay	Washed clay
O	"A" paper clay	Old Hickory Clay & Talc Co., Hickory, Ky.
P	Ferric oxide (Fe_2O_3)	Ball-milled 72 hours
Q	Bennington kaolin	Washed clay, Bennington, Vt., Vermont Kaolin Corporation
R	Magnesia (MgO)	Light; ball-milled; 100 hours wet
S	Magnesium hydroxide	$Mg(OH)_2$ precipitated, washed, and filtered; second run made of dry material wedge up
T	Cyanite	Cello Mines, Barnsville, N. C.; contains a little mica; ball-milled, 72 hours wet
U	Titania (TiO_2)	Technical
V	Titania (TiO_2)	Same; ball-milled wet for 120 hours
W	Potters flint	Through 200-mesh
X	Potters flint	Same; ball-milled wet for 100 hours
Y	Maine feldspar	Oxford Mining & Milling Co., West Paris, Maine; through 200-mesh
Z	Dark English ball clay	Same as A

II. Materials

There are given in Table I the names, sources, and preparation of the materials used which were selected to cover a wide range from plastic

* For the Annual Meeting, American Ceramic Society, Pittsburgh, 1932. Received November 5, 1932.

to nonplastic substances. A letter is assigned to each material, and this symbol will be used throughout.

III. Apparatus for Measuring Shrinkage

The apparatus constructed for the shrinkage measurements is clearly shown in Fig. 1. It consists essentially of a controlled drying chamber,

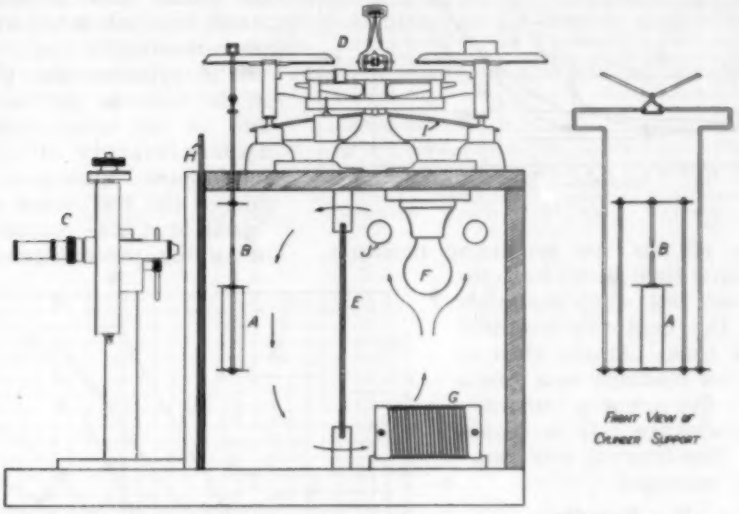

FIG. 1.—Apparatus for measuring shrinkage: *A*, clay cylinder, *B*, reference points, *C*, reading telescope, *D*, balance, *E*, opal glass baffle, *F*, light, *G*, heater, *H*, plate glass, *I*, spring stop to prevent jars, *J*, vent holes.

a balance to weigh the specimen continuously, and a moving microscope to measure the specimen length. The reference points for measuring the specimen were set close together so that readings could be taken rapidly. The specimen was in the form of a cylinder approximately 50 to 120 millimeters long, 25 millimeters in outside diameter, and with a 3-millimeter wall thickness. This form of specimen was selected to give mechanical stability and rapid drying.

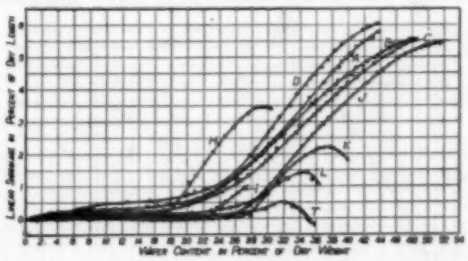

FIG. 2

The specimen could be weighed with a precision of ±0.05 gram and the length measured within ±0.01 millimeter. A weighing and a length measurement could be taken within 15 seconds so that the time error was small.

IV. Method of Making Tests

All materials were wedged thoroughly and aged 24 hours. The water content was as great as would allow handling the material. After a

second wedging the material was then formed into a cylinder by rolling it around an oiled glass tube. Even the less plastic substances could be handled with care in this way. The cylinder was then trimmed off square and allowed to stand in a saturated atmosphere overnight.

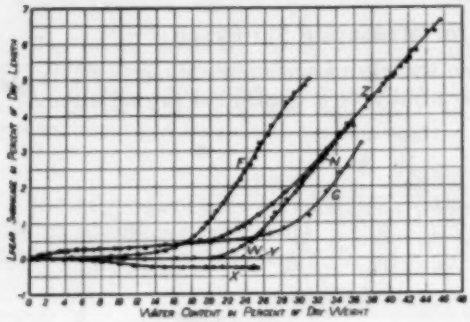

FIG. 3.

The cylinder was placed in the tester in the morning and an air temperature of approximately 50°C was maintained until near the end of the test, when additional heat was required to drive off the last remaining moisture. The drying process generally required eight hours for completion, but some materials like the bentonite required more time. At the start of the run readings were taken every five minutes, but when the shrinkage rate decreased this time-interval was somewhat increased.

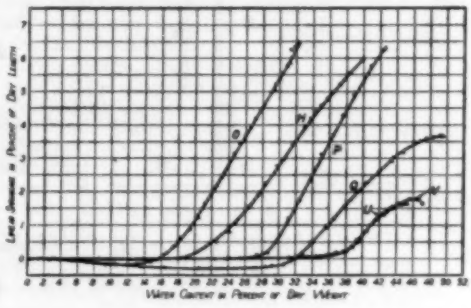

FIG. 4.

V. Results

The shrinkage curves for the materials tested are shown in Figs. 2, 3, 4, and 5. In general, the shrinkage is proportional to the loss in water at the start. It will be noted that all of the curves in this region have approximately the same slope, and this slope is such that the decrease in clay volume is equal to the volume of water lost.

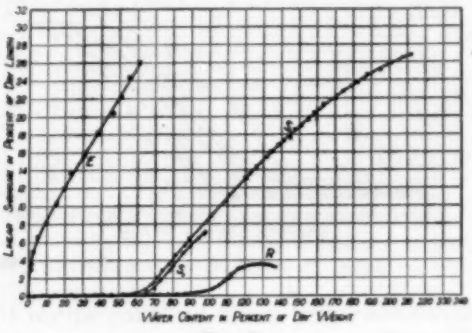

FIG. 5.

At some water content the rate of shrinkage decreases, and the curve approaches zero or some definite small value which is maintained until only a few per cent of water remains. The first shrinkage is called primary shrinkage, and the other, secondary shrinkage. A few materials show a negative secondary shrinkage, that is, an expansion.

At the start of the test, water is lost in many cases with little or no shrinkage. This is due to the fact that equilibrium conditions are not

established in the specimen at once. The fact that some specimens show a slight initial expansion is difficult to explain, although it has been noticed that many clays show an expansion shortly after mixing with water.

The important characteristics of these curves are summarized in Table II.

The magnesium hydroxide showed a large shrinkage on the first drying (curve S_1). A second wetting and drying gave curve S_2 which is the same as the first one except that much less water was retained in the mass. Subsequent dryings gave curves identical to S_2 showing that complete reversibility had been reached.

Cylinders were made up of $Fe(OH)_3$ and $Si(OH)_2$ which had been freshly

TABLE II

Symbol	Lowest water content for filled pores (%)	Amount of secondary shrinkage (%)	Total shrinkage (%)	Water content where shrinkage reaches constant value (%)	Chemically combined water (%)	Increase in H_2O in saturated atmosphere (%)
A	30	+0.3	5.8	14	16*	8
B	28	+0.2	5.6	16	13	15
C	29	+0.2	5.6	16	14	10
D	29	+0.5	6.0	12	20*	7
E	4		large		5	32
F	20	+0.1	5.0	11	4	5
G	34	+0.4	4.0	18	9	6
H	26	0	6.0	18	6	6
I	23	0	1.0	22	30	3
J	29	0	5.5	23	13	4
K	29	0	2.2	25	15	1
L	29	+0.1	1.4	17	7	10
M	19	0	3.5	15	7	4
N	26	0	3.7	20	12	2.5
O	20	−0.1	6.5	14	10	4
P	30	0	6.8	26	1.2	3
Q	32	−0.3	3.7	28	11	6
R	107	+0.2	3.6	75	31	29
S	67	0	7.0	57	45	
T	30	+0.5	0.5	17	0.8	2.2
U	39	0	1.7	30	16	4
V	39	0	1.8	30	0.7	1.0
W	26	0	0		0	0.1
X	26	−0.25	−0.25		0	0.2
Y	26	0	0		0	0.0

* Due to charcoal.

precipitated and washed. Their shrinkage was too great to be accurately measured, and they were irreversible, *i.e.*, they could not be dried and rewet to give plasticity.

The shrinkage of titania was determined in the condition it was received, and after wet ball milling. The shrinkage curves were similar in both cases, but the milling removed considerable of the chemical water. This seems strange, but was checked several times.

VI. Mechanism of Drying Shrinkage

The mechanism of drying as applied to finely divided substances is comparatively simple. As previously stated all plastic materials on drying from a soft consistency lose bulk volume at the same rate that they lose water volume, down to a certain point. In other words, the

pores are completely filled during the first portion of the shrinkage, the particles drawing together as the water films decrease in thickness. When these films are reduced to zero, or in the case of clays with a secondary shrinkage, to their minimum stable thickness, the particles touch and air begins to enter the pores to replace the water.

This condition is made clearer by Fig. 6 where the porosity and filling of the pores of clay (G) are shown. These data were obtained by drying cylinders of the clay in an initially wet, plaster box with great slowness. From their weight, their volume, and the specific gravity of the clay, the porosity was computed for each water content.

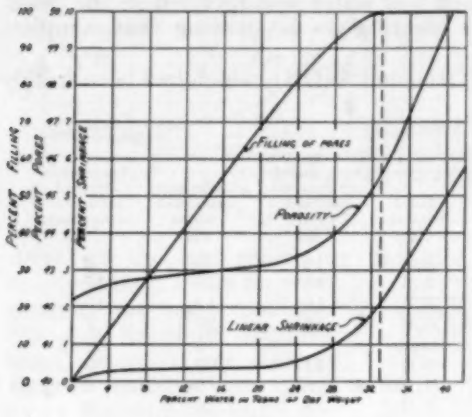

FIG. 6.

In Fig. 7 there is shown several stages in the process of drying according to the evidence available. In (*A*) the particles are separated by a considerable thickness of water film which gives the clay its best working condition. In (*B*) enough water has been lost to allow many of the particles to touch and the shrinkage is slowed up and soon after stopped. In (*C*) more water has been removed, and air bubbles appear in the center of the pores. In (*D*) all the free water is gone and only a little remains in a hydrated layer surrounding the particles. When the clay is completely dry (*E*) even this layer is gone, and the particles are held firmly together. In some clays this hydrated layer is not present, and particles reach their final position when considerable water remains in the clay.

FIG. 7.

It will be seen that the process of drying requires the condition of a water film which always tends to reach a condition of equal thickness over all the particles. That is, the attractive force on a thin film is greater than on a thick one, which causes the equalization of the water content in any mass of porous material.

VII. Drying Shrinkage and Plasticity

The amount of water remaining in the materials after drying at 110°C was determined after heating to 800°C. The amount of water picked up by the clay when maintained in a saturated atmosphere was also measured. These data are given in Table II. It will be evident at once that there is no correlation between these properties and the plasticity of the material but it is clear from these results that to have plasticity a material

must have some combined water and an active surface to absorb hydroscopic water. It is also shown that plastic properties are not confined to hydrated aluminum silicates, as the ground ferric oxide, for example, had all the properties of a clay such as plasticity for molding or throwing on the wheel, drying shrinkage, dried strength, casting properties, and reversibility. The titania showed the same properties to a lesser extent, and undoubtedly there are many other substances that can be made to develop plasticity by wet grinding to produce an active surface on the particles.

Plasticity is undoubtedly due to an active particle surface which has the property of attracting to it a stable water film. This attractive force both holds the water in the pores and the particles together. A nonplastic material like potter's flint may be made to have a slight plasticity when constantly agitated so as to maintain water films; at rest, however, the water escapes and the particles touch each other. It would seem, therefore, that any material showing plasticity must shrink on drying.

The fineness of the material while having some effect on the plasticity does not govern it as the wet-milled flint was finer than many of the clays. The dark English ball clay was settled into three equal fractions, as shown in Table I, and while a particle-size analysis showed considerable difference in size betweent he different fractions there was no great difference either in plasticity or shrinkage.

The addition of an equal weight of flint to the dark English ball clay, of course, reduced the plasticity and shrinkage, but most interesting is the fact that the secondary shrinkage was eliminated.

The cause of the negative secondary shrinkage shown by a few materials is not evident. The expansion may be due to a release of strain in some of the plate-like particles with the removal of the water.

Particle-size analyses were made of all the materials tested in order to arrive at the thickness of the water film as previously determined.[1] While the value for the film thickness averaged 3 by 10^{-5} centimeters for the clays, it was felt that the method of obtaining the particle size in the smaller ranges has not been sufficiently developed to allow a very precise determination of this important factor.

VIII. Conclusions

From these observations the following conclusions are drawn:

(1) Clay-like properties are not confined exclusively to hydrated aluminum silicates.

(2) Materials showing plasticity must have some permanently attached water.

(3) Plasticity is always accompanied by air-drying shrinkage.

(4) Plastic materials absorb considerable moisture in damp air, due to the active particle surface.

(5) Some clays, generally the more plastic ones, show a secondary shrinkage.

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EDITORS NOTE: See also *Bull. Amer. Ceram. Soc.*, **7** [5], 130 (1928) for Bibliography on Plasticity.

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ELIMINATION OF BLISTERING OF ENAMELED-IRON NUMBER PLATES*

By W. J. Scott

ABSTRACT

In the manufacture of enameled-iron number plates for dials on pay-station telephones, blisters, formed in the enamel during the low-temperature firing of the printed characters and background, resulted in an average process loss of 14%. Proposed remedies tried without success were (1) the use of different enamels and enameling irons, (2) firing the characters at other temperatures than the standard temperature of 1310°F, and (3) special treatment of the iron surface before enameling, such as deep steelblasting, heating at 1310°F prior to enameling, or copper plating. The blistering was finally eliminated by increasing the length of the heating-up period in the character firing operation.

I. Introduction

The vitreous enameled number plate under discussion was developed for use on pay-station telephone dials which, because they are often placed in relatively dark locations, require more easily discernible characters than those of the smaller number plate ordinarily used. The iron base of this number plate is a flat ring 3.06 inches in inside diameter, 4.33 inches in outside diameter, and 0.063 inch thick. A radius of 0.094 inch is turned on the inside and outside edges of the face side of the blank. The blank is cleaned for enameling, first by acid pickling and then by steelblasting by the tumbling barrel method. After steelblasting, threaded mounting studs are electro-welded on the back of the plate. A blue ground coat is then sprayed on both the face and the back of the plate and two white coats are sprayed on the face only. The blue coat is fired at 1610°F for two and one-quarter minutes and each of the white coats at 1510°F for two minutes. The firing is done in continuous rotary-hearth electric furnaces. After these firing operations the printed background and characters are applied to the white enameled plates in a number of successive printings with ceramic inks. Prior to the changes in process which were made to eliminate blistering, the plates were fired between each printing at 1310°F for two minutes to mature the ceramic inks.

(1) Occurrence of Blistering A serious difficulty in the manufacture of these number plates was the occurrence of blistering of the enamel during one or more of the firings of the printed characters and background at 1310°F. The largest percentage of the plates rejected for this defect showed the condition after the first character fire, although it frequently occurred for the first time during subsequent firings. The percentage of blistered plates varied from day to day between 1 and 60% of the day's output, the average being about 14%. The average number of blisters per plate was about thirty although many plates with fewer blisters were rejected. When a considerable number of average-sized blisters were present, they usually occurred in patches rather than being uniformly distributed. When the blisters were small the distribution was more uniform. Number plates which had blisters on the face usually, but not always, had them in the ground-coat enamel on the backs as well.

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* Presented at the Annual Meeting, American Ceramic Society, Washington, D. C., February, 1932 (Enamel Division). Received September 27, 1932.

(2) Description of Blisters The blisters were hemispherical in shape and unbroken. They varied considerably in size but averaged about $^1/_{32}$ inch high. Some of the blisters, when broken open, appeared to originate at the metal surface, others within the enamel coating. Due to the prominent position of the number plate on the telephone, the blisters constituted a serious defect as they marred the appearance of the enamel surface and all but the smallest blisters caused the rejection of the plates.

II. Investigation

Plates which had blistered badly were steelblasted and reënameled, but it was found that these were no more liable to blister again in the character fire than were the regular run of product. Plates on which the blisters had been smoothed out by firing at 1510°F appeared to blister when refired at 1310°F somewhat more often than other plates but not sufficiently so to make them of value as control parts. It was necessary, therefore, to make preliminary trials of proposed remedies on lots of one hundred to five hundred plates so that even the minimum tendency to blister would result in one or more defective plates.

(1) Study of Materials As the various operations in the manufacture of the number plates are under fairly close control, the enamels, which are purchased ready to use, and the enameling iron were first investigated as possible sources of the trouble. Fresh supplies of these materials and other materials from different manufacturers were tried without success. Some enameled-iron pieces obtained from other enamelers blistered when fired under the character firing conditions. A more refractory ground coat fired at 1600°F for five minutes was also unsuccessful.

(2) Iron Cleaning At the suggestion of the suppliers of the iron, a lot of blanks was cleaned by acid pickling only, and on another lot steelblasting rather than sandblasting was used, but in each case without noticeable improvement. Steelblasting to a greater depth by prolonging the time in the steelblasting barrel was likewise without apparent effect.

(3) Long Heat Treatment A quantitative test on the amount of gas expelled from a sample of the enameling iron under conditions of reduced pressure and gradually increasing temperature revealed that the evolution of gas was greatest between 1300°F and 1400°F. It was impracticable to heat the iron blanks under reduced pressure, but a test was made in which they were given a prolonged heating under atmospheric pressure at the character-firing temperature of 1310°F. This treatment was unsuccessful in reducing the defect.

(4) Copperplating The usual type of dial number plates which have a copper base 0.010 inch thick and which are given one character firing of a shorter duration but otherwise under the same conditions as the larger iron base plates do not show this blistering, and it was felt that possibly a copper coat on the iron plate would be beneficial. Some enameling-iron blanks electroplated with copper and also some blanks made from a commercial copper coated sheet iron failed, however, to show any improvement in respect to blistering when enameled by the usual process. In further experiments with enameled copper pieces, it

was found that blistering occurred in the enamel on copper blanks 1/32 inch thick when fired at 1450°F for one minute.

Changes in the character firing temperature from 1310 to 1100°F, 1200°F, and 1400°F were tried but without effect except that the blistering appeared to be somewhat increased at the highest temperature.

III. Elimination of Blistering

The first reduction in the amount of blistering was brought about by eliminating three of the character-firing operations. This was accomplished by substituting baking operations at 300°F which hardened the ceramic inks sufficiently to prevent marring in the subsequent printing operations. This change from five to two character firings reduced the amount of blistering approximately 50%.

The second change, by which the blistering was almost entirely eliminated, was the result of experiments in which the length of the firing period and the temperature of the entrance side of the character-firing furnace were varied. It was first observed that when the firing period was decreased from 2.1 minutes to 1.2 minutes and the temperature of the entrance side of the furnace increased from 1300 to 1400°F, 75% of the plates were blistered in one firing. These results suggested that the opposite effect, or a reduction in blistering, could be obtained by increasing the length of the heating-up period during the character firing. The length of the character-firing period was accordingly increased from 2.1 minutes to 4.4 minutes and the temperature of the entrance side of the furnace was decreased from 1310 to 1160°F. Since the introduction of this change in process, no blisters have been obtained except occasionally on the extreme edges of the plates where they can be ground off and the plates repaired. As these few blisters occur only on the rounded edges which heat up more quickly than the remainder of the plate, it seems probable that they could be prevented by heating the plates more slowly during all or part of the heating-up period.

As the too rapid heating of the plates in the character furnace appeared to be the cause of blistering, it was considered of interest to determine whether the reverse procedure of rapidly cooling heated plates would increase their tendency to blister upon subsequent reheating. Cooling plates from 1500°F in a blast of cool air did not produce this effect in the few tests made, but when either copper- or iron-enameled plates at approximately 500°F were quenched in cold water, wiped off, and heated to 1300°F, either quickly or slowly, they became covered with blisters similar to those under discussion, except that most of them were irregular in shape. The enamel of the quenched plates presented a normal appearance before refiring except that in some cases careful examination showed many short hairline cracks.

IV. Conclusions

Although this investigation was not continued far enough to obtain a definite theoretical explanation of the trouble, the blistering was eliminated under the given conditions as a result of establishing an empirical relationship between the tendency to blister and the rate of heating in the character furnace. It appears that this type of blistering is more or less definitely related to the time-temperature cycle to which the enamel is subjected in firing. If this is true, it should be possible to develop for any vitreous enameled product a firing cycle which is best suited to that product from the standpoint of blistering.

WESTERN ELECTRIC COMPANY, INC.
HAWTHORNE WORKS
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GRAPHITE AS A REFRACTORY*

By Richard H. Stone

ABSTRACT

(1) Some properties of graphite are discussed and industrial applications as a refractory are enumerated. (2) Previous work on graphite, particularly during the World War on graphite crucibles, is reviewed. That work was directed toward finding substitutes for imported graphites and clays. Since peace-time conditions were restored the manufacturers have returned to foreign sources of raw materials and some reasons for this tendency are advanced. (3) Analyses of several foreign and domestic graphites are tabulated. (4) Reports are given on experiments on the thermal conductivity of clay-graphite bodies with the effect of varying percentages of graphite on the conductivity.

I. Character of Graphite and Its Use

Graphite as a refractory has unique properties which distinguish it from other refractories, chiefly, its thermal and electrical conductivity. The combination of high thermal conductivity with a melting point[1] of 3800°C ± and a high resiliency and elasticity make it indispensable in the manufacture of melting receptacles.

Graphite in combination with other grog, or alone, and with suitable binders such as clay or pitch or tar is used in the manufacture of crucibles for melting nonferrous metals and steel, for retorts for distillation of secondary zinc, for steel ladle stopper heads, and for resistor heating elements. It is also used for foundry facings, as a coating for ingot molds where it is preferred because there is no generation of gases when submerged by the steel, and in mortars for making up steel ladle stopper rods.

While the consumption of graphite crucibles was greatly reduced by the gradual discontinuance of crucible steel production, the crucible manufacturers felt some encouragement in the satisfactory increase in crucible consumption in nonferrous melting in 1929 over the preceding year.

The manufacturers of graphite refractory products are seeking constantly for new applications and it is likely that these when found will make use of its properties of thermal or electrical conductivity where it can be, or is, protected from oxidation.

An objection to graphite is its ease of oxidation which takes place readily at 700°C in air leaving from 5 to 20% ash. This objection may be largely overcome by protection with a ceramic glaze as discussed later.

The manufacture of graphite refractory articles requires a great deal of experience and skill. The graphite is unctuous and greasy and bonds with difficulty. It is usually bonded in the proportion of 60% graphite and 40% clay and any great deviation will lead into difficulties. Slips with ineradicable "slicks" are extremely difficult to avoid.

The subject of graphite as a refractory has received considerable attention in the American Ceramic Society, particularly in 1919 and 1920 when interest was focused on the subject due to the war-time demands. A brief reference to the work with comments in the light of developments since that time may not be amiss, particularly as progress in the manufacture of crucibles has resulted in a product that will give twice the service today in nonferrous melting that was customary in 1920.

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* Presented at the Annual Meeting, American Ceramic Society, Cleveland, Ohio, February, 1931 (Refractories Division).

[1] E. Rishkevisch, *Z. Electrochem.*, **31**, 54–63 (1925).

During the period mentioned, there were two papers on graphite ash and its influence on the softening point of the bond clays. Booze[2] showed that the fluxing action of the ash would seldom prove detrimental. That is, the graphite ash might soften at cone 1, and, on mixing in the customary proportions with the bond clay, the softening point of the latter might be reduced 2 or 3 cones; but the same reduction was observed with graphite ashes which softened at cone 17 or 18.

The second paper was that of Long[3] in which he advanced the idea that graphite with a carbon content of 85% or lower might be beneficial due to the ability to form glazes. Since Long's paper, many different graphites have been investigated with respect to their contribution to the properties of the self-glazing crucible which appeared with Jackman's patent[4] in 1926. Analyses of some of these graphites are shown in Table I. Graphites I, III, IV, and V with both low and high fusion

TABLE I

ANALYSES OF GLAZING AND NONGLAZING GRAPHITES

Graphite	I (imported)	II (imported)	III (Texas)	IV (Alabama)	V (imported)	VI (imported)
Carbon	81.87	85.77	89.32	85.64	84.88	85.34
Ash	18.13	14.23	10.68	14.36	15.12	14.66
P.C.E. (ash)	15–16	15–16	10	15	26–27	26–27
Silico	50.20	53.30	55.10	56.20	47.96	51.94
Alumina	37.57	27.04	22.70	26.41	37.08	33.13
Fe_2O_3	8.88	15.02	10.66	8.97	12.02	10.91
CaO	0.48	0.83	0.84	1.33	0.55	0.61
TiO_2	0.55	0.62	1.24	0.89	0.70	0.80
MgO	1.28	1.98	4.55	1.71	0.37	1.32
Alkalis	1.38	1.45	5.29	4.77	1.46	0.48
MnO	Trace	0.21	Trace	Trace	0.30	0.34
Glaze	Yes	None	Yes	Yes	Yes	None

ashes all glaze, while II with cone 15 ash and VI with cone 26 ash do not glaze; also, I with 1.38% alkalis in the ash glazes, while II with 1.45% does not. It is now thought that it may be the ratio of potash to soda in the graphite ash which causes a good glazing crucible. This will be investigated further.

Stull[5] contributed an article on the use of domestic graphites arriving at the conclusion that crucibles as large as a No. 70 might be made successfully from Alabama flake graphite. He applied the same rules to the crucible aggregate as that found to hold in other refractories or cement mixtures, that the larger the body the larger the required grog size. It is noteworthy that now, after the pressure incident to the War to use domestic materials was removed, practically all the manufacturers of crucibles using flake graphite import this material to obtain the larger flake.

The choice of clay used represents another case of a return to an imported material as soon as the supply was reëstablished after the War.

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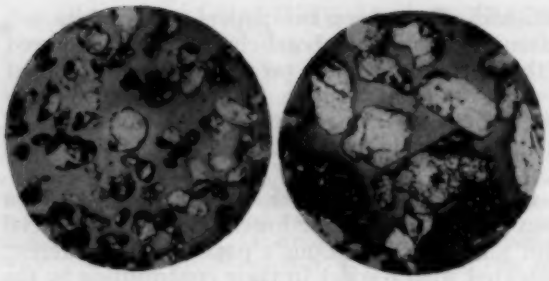
[2] M. C. Booze, "Fusibility of Graphite Ash and Its Influence on the Refractoriness of Bond Clay," *Jour. Amer. Ceram. Soc.*, **2** [1], 65 (1919).

[3] R. N. Long, "Fusibility of Mixtures of Graphite Ash and Bond Clay," *ibid.*, **3**, 626 (1920).

[4] U. S. Pat. No. RE 16,845.

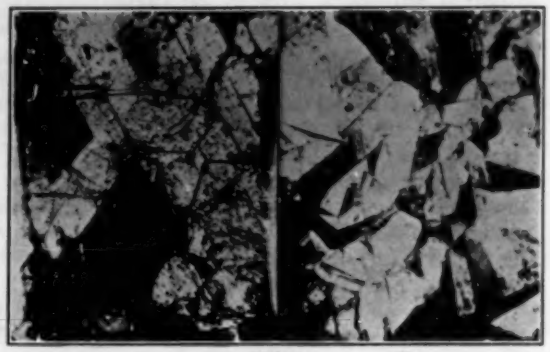
[5] R. T. Stull, "Behavior under Brass Foundry Practice of Crucibles Containing Ceylon, Canadian, and Alabama Graphite," *Jour. Amer. Ceram. Soc.*, **2** [3], 208 (1919).



A 20× B

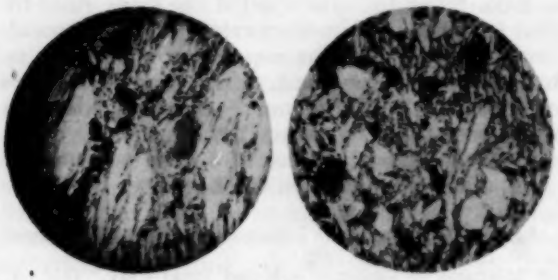
FIG. 1.—(*A*) Small flake Alabama graphite. (*B*) Madagascar graphite (photomicrograph, R. Thiessen).

Booze, Stull, Schurecht,[6] and Bleininger[7] all found American clays that had many characteristics that made them suitable as a substitute for German clays in the manufacture of crucibles. A study of Booze's tabulation of the properties of all these clays, however, shows the following definite characteristics of the German Klingenberg clay, which may account for its selection when the choice is free. Booze noted that both graphite and feldspar tend to equalize cooling strains and Klingenberg clay contains 6% feldspar. Of twenty American and foreign clays, Klingenberg also shows the highest transverse strength when air-dried and the third highest in transverse strength after firing. Perhaps the most important of its characteristics in relation to graphite is the protection it affords against the oxidation of the graphite. Thus, in a comparative test, the graphite bonded with Klingenberg was only 50% burned out whereas, under the same conditions, it was all burned away when bonded with one of the American clays, none of which afforded



A 500× B

FIG. 2.—(*A*) Madagascar graphite flake showing overlapping, flat plate-like structure. (*B*) Ceylon graphite particle showing thicker truncated crystals easier to bond but giving a body with less strength and permeability (photomicrograph, R. Thiessen).



A 20× B

FIG. 3.—(*A–B*) Sections of crucible bodies made with flake graphites; light areas are the graphites.

[6] H. G. Schurecht, "Effect of Electrolytes on the Properties of Graphite Crucible Bodies," *Jour. Amer. Ceram. Soc.*, **2** [6], 443 (1919).

[7] A. V. Bleininger, "Properties of American Bond Clays," Bur. Stand., *Tech. Paper*, No. 144.

as high a degree of protection as the Klingenberg. The one characteristic in which Klingenberg shows the poorest rating is in loss of transverse strength after quenching. As this is a stress to which a crucible in service would almost never be subjected it forms no consideration in the selection of a bond clay. While Booze was unable to make tests of transverse strength of crucible mixes at high temperatures, due to oxidation of the test specimen, such tests may now be made through the development of the self-glazing bodies. The strength, however, is not great, being about 50 pounds per square inch modulus of rupture. The elasticity is very low but a graphite and clay structure at 2600°F has a high plasticity, that is, it may be deformed without rupture. Crucibles can be and frequently are squeezed elliptically without injury or shortening their life.

A 200× *B*

FIG. 4.—(*A*–*B*) Sections of crucible bodies made with Madagascar graphite; light areas are the graphite (photomicrograph, R. Thiessen).

The paper by Thiessen[8] was illustrated by photomicrographs of various graphite grains and crystals as well as sections of crucible bodies of English and American manufacturers (Figs. 1, 2, 3, and 4). Of the relative surfaces of the graphite grogs and their relation to the problem of bonding, he says that the greater surface for the same mass of the flake graphites as compared to the Ceylon with its polyhedral particle shape may be compensated for by a finer dispersion of the clay. This has been achieved in some cases by blunging the clay and water together and adding the slip to the grog in the mixer. Attempts have been made to use electrolytes

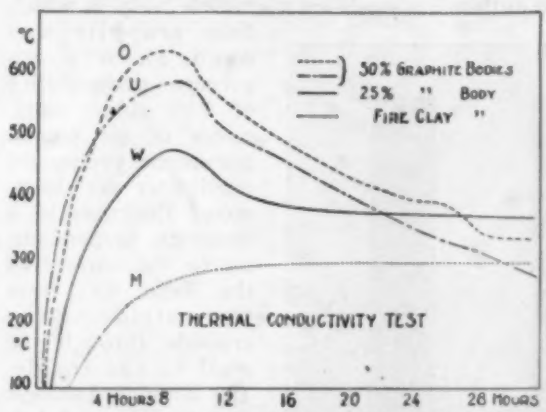


FIG. 5.—Curves showing influence of graphite on thermal conductivity of clay bodies; conductivity after rising to maximum decreases due to oxidation of the graphite.

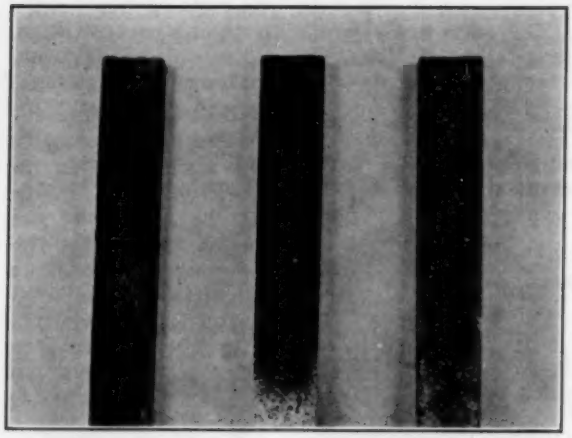
[8] R. Thiessen, "Structure of Graphite in Relationship to Crucible Making," *Jour. Amer. Ceram. Soc.*, **2** [7], 508 (1919).

and while they seem to improve the working qualities of the mix no improvement was discernible in the service rendered by the crucibles.

Examination of Thiessen's photomicrographs of sections of crucible

FIG. 6.—Equipment used in relative thermal conductivity test.

bodies made with the flake graphites reveal clearly why this type of body has a low permeability even though the porosity is relatively high (Figs. 3 and 4). Tests which the author has made on a crucible body in which flake graphite was used showed an average permeability of 0.81 cubic centimeter of air passed per second per square centimeter per centimeter thickness in a direction perpendicular to the surface of the flake, *i.e.*, from the outside of the crucible through the wall to the inside. The laminated shingle construction inhibits the passage of gases in that direction. The apparent porosity averages 22%. This same construction retards oxidation of the crucible wall.



O *U* *W*

FIG. 7.—Sections of pieces *O*, *U*, and *W* used in the conductivity test illustrated by Fig. 5. In *O*, unoxidized portion shows lighter; in *W*, darker; in *U*, this portion is scarcely discernible.

Thiessen showed that a block cut from a crucible wall made of flake graphite oxidized twice as fast from the edges of the piece as from the face which had been the outer surface of the crucible.

A relative thermal conductivity test made at the American Refractories Institute Laboratory at Mellon Institute showed the influence on conductivity of the removal of graphite by oxidation. The equipment used in the conductivity test is illustrated in Fig. 6. The Carborundum plate is electrically heated and in the conduct of the test reached its final temperature of 1350°C at the end of four hours. In Fig. 5, curves *O* and *U* show the conductivity of the bodies containing approximately 50% flake graphite while *W* contains but 25% graphite.

Figure 7 shows the pieces *O*, *U*, and *W* in section after the conductivity test. There are several factors involved in producing the results observed. The bottom was of course at the highest temperature and exposed to air seeping in along the base plate of the apparatus. In the section above and extending more than half-way up the column where the graphite is least oxidized the temperature was high enough to ignite the graphite but the percentage of oxygen in the atmosphere was reduced by supporting the combustion lower down. In the top $^1/_3$ zone the graphite burned away showing that the temperature was still high enough to oxidize the carbon and sufficient oxygen was available from infiltration of air from the top through the insulation. Radiation cooled the top of the piece sufficiently to retard oxidation and there was considerable carbon left.

The object of the above test was of course to obtain an indication of the relative thermal conductivity with varying percentages of graphite and this is shown by the curves of Fig. 5.

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CONSTITUTION AND THERMAL EXPANSION OF SILICA COKE-OVEN BRICK AFTER SERVICE*

By J. B. Austin and R. H. H. Pierce, Jr.

ABSTRACT

Two silica brick which were in service in a coke oven for over ten years have been examined under the petrographic microscope. At the flue side the brick were almost completely converted to cristobalite, next comes a relatively thick layer which is mainly tridymite, and finally near the coke side quartz is found in addition. Measurements on small specimens taken from one of the brick show that the several layers have very different expansions. It is concluded that in cooling a battery of ovens great care should be taken to cool slowly through the temperature range 200 to 300 °C.

I. Introduction

The studies described in this paper were undertaken in connection with the question of how batteries of by-product coke ovens can be cooled with safety. The problem is essentially an engineering one, involving the stresses caused by cooling and contraction in a large and complex structure. It is peculiar, however, in that the principal material of construction of the oven is silica brick and the sudden volume changes that occur at the inversion points of the forms of silica are responsible for stresses that would be much less in a structure built of such materials as fireclay brick or magnesite brick.

The properties of new silica brick are fairly well known, but it is to be expected that silica brick which have been in service for several years in a coke oven will have had their constitution radically altered. Since existing information on the subject is fragmentary and not very satisfactory it was necessary to supplement it with an examination in the laboratory of suitable samples of brick whose history was known.

II. Material

Five brick which had been in service as liners in the walls of coke ovens for a number of years were secured. These proved to be quite similar in structure so that only two, which were selected as representative, needed to be examined in detail.

Note: It should be emphasized that the constitution of these samples was typical of what was to be expected from their thermal history. The term "constitution," as used here and throughout this paper, refers to the modifications of silica present and not to the actual size of the several zones or vertical layers of material found to exist in the brick. The thickness of these layers showed considerable variation from brick to brick but the grouping of the modifications of silica present in corresponding layers was nearly always the same.

III. Specimens

The first brick was taken from the discharge side of the north wall of an oven at plant "J" and was the fifth brick above the floor in the fifth vertical flue of the oven. During the eleven years of its service the average range of the flue temperature was 1168 to 1260°C (2134 to 2300°F) as read by an optical pyrometer. The flue side of the brick (see Fig. 3) as received consisted of a layer of relatively hard and dense white material. This showed a gradual transition to other and more grayish layers

* For the Annual Meeting, American Ceramic Society, Pittsburgh, Pa., February, 1933 (Refractories Division). Received October 20, 1932.

until on the coke side the material was quite black although interspersed with spots of grayish or white silica.

The second brick came from the "9th tier above the floor in the 14th flue from the pusher side of the east wall" in an oven in plant "G," and had been in service for approximately twenty years. It was made up of layers similar to those of the first brick, the only visible difference being in the color, which was a brown rather than gray.

IV. Results

(1) Petrographic Examination

Thin sections of the material forming each of the visibly distinct layers were examined by Olaf Andersen of this laboratory. Figure 1 (two views)

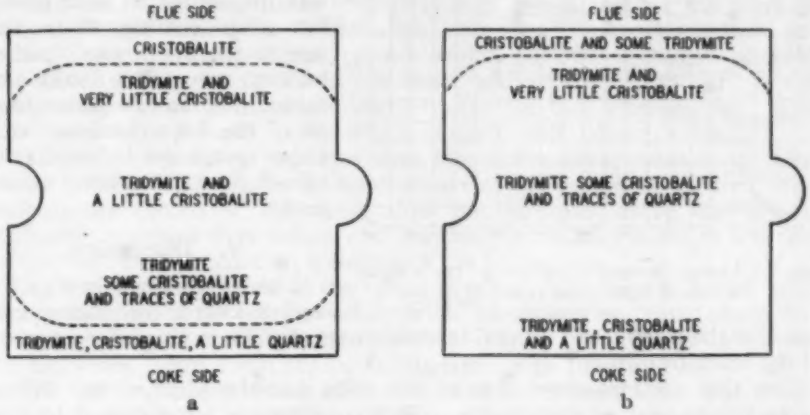

FIG. 1.—Cross-section of silica brick showing constitution after service as observed with the microscope.

shows the most essential results insofar as they have any bearing on the present problem.

(2) Dilatometric Examination

Since the petrographic examination showed that the constitution of the two brick was practically identical and since the thermal expansion is essentially determined by the constitution, it was decided that measurements of the three principal zones in one brick would be sufficient. Accordingly data were obtained on the first brick.

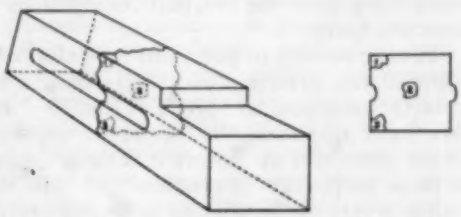

FIG. 2.—Silica coke-oven shape: 1, flue side, 2, center, 3, coke side.

Three sets of specimens in the shape of small cones approximately 5 millimeters in height were cut from this brick, one set from the white layer at the flue end, another set from the black layer at the coke end, and a third set from the center. The position of the samples in the brick is

illustrated in Fig. 2. The expansion was measured by the interferometer method which has been described in a previous paper.[1]

The results are shown in Fig. 3 which gives the change in length of the specimens on heating. No data for cooling were obtained and only one run was made on each set except on the specimens from the flue end. For these the expansion at the cristobalite inversion point, just above 200°C, was so great that small variations in the composition or temperature of these specimens resulted in such a crowding of the interference fringes that it was impossible to read them; but after cutting down the size of the specimens a satisfactory curve was finally obtained. It may be added that all of the data obtained with these specimens below 200°C showed satisfactory agreement.

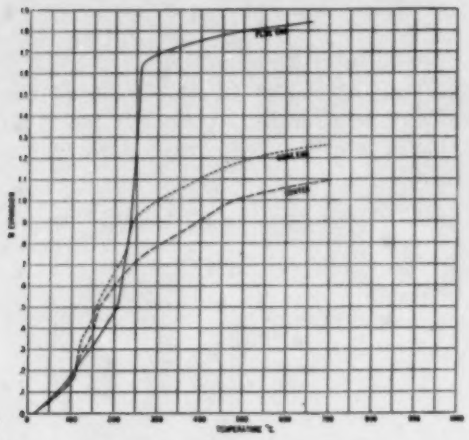

FIG. 3.—Linear thermal expansion of the several layers of brick from plant "J."

V. Discussion

The data shown in Figs. 1a and 3 afford convincing evidence of the presence of several modifications of silica in the different parts of the brick from plant "J."

The thin sections show that at the coke side the silica occurs chiefly as tridymite and as cristobalite. This constitution is confirmed by the relatively sudden changes in length occurring at 117°C (240°F) and 165°C (330°F) which are characteristic of the tridymite inversions at these temperatures, and by the pronounced change at 230°C (445°F) which accompanies the inversion of cristobalite. From the magnitudes of these changes it is estimated that cristobalite is present in the coke side in much smaller amounts than is tridymite. This distribution probably represents something near the original constitution of the brick as it came from the manufacturer.

It may be well to point out here that while the petrographic examination showed the presence of a little quartz at this end, no indication of the quartz inversion at 573°C (1063°F) appears on the expansion curve. We have observed this apparent suppression of the quartz inversion in other cases and we believe it is to be expected in any silica brick containing a large proportion of cristobalite. The explanation appears to be that the outer layers of the coarser quartzite grains used in making the green brick are usually converted to cristobalite during the firing of the brick, while the core of the large grain remains unaltered. On subsequent heating the cristobalite shell, in passing through its inversion temperature, suffers such a large increase in size that it draws away from the core leaving a small grain of quartz enclosed in what is equivalent to a hollow shell.

[1] J. B. Austin, *Jour. Amer. Ceram. Soc.*, **14**, 795 (1931).

When the quartz inversion is reached, its magnitude is relatively so small that the core does not refill the hollow shell and the expansion produces no visible outside effect.

Examination of the center portion of the brick shows that it is composed chiefly of tridymite. This conclusion is in agreement with the evidence deduced from the expansion curves. This particular constitution is probably to be interpreted as meaning that the center of the brick was usually at a temperature above 870°C (1600°F) and below 1470°C (2680°F) which are the temperature limits of the stability range for tridymite. The cristobalite originally present has been converted into tridymite so that this part of the brick is essentially pure tridymite.

The specimens from the flue side show the large change in length, beginning at approximately 210°C (410°F), which is characteristic of cristobalite. The magnitude of this change indicates that the silica is present almost entirely as cristobalite. This was not to have been expected from the temperature record, which showed a range of 1168 to 1260°C (2134 to 2300°F) in the flues, while 1470°C (2678°F) is the lower temperature limit of the stable range for this modification. The fact that this cristobalite layer, which is fairly well defined, extends some distance into the brick indicates that this entire layer must have been above 1470°C (2878°F) for at least a part of the period of service. The temperature record of the ovens does not indicate where the optical pyrometer readings were taken, and they may have been made in a cooler part of the battery than that from which the brick came.

The temperature record of the ovens at plant "G" accords better with the constitution of the corresponding brick, which was examined under the microscope but not dilatometrically (Fig. 1b). The average range for the six years (1926 to 1931) in the battery was 1409 to 1467°C (2568 to 2672°F) and a maximum of 1487°C was twice recorded. The lower limit for cristobalite is 1470°C. This record is therefore consistent with the observed formation of a thin layer of cristobalite on the flue face together with complete conversion to tridymite in the interior of the brick.

VI. Conclusions

The expansion data indicate strikingly the danger attendant on a rapid heating or cooling of the lining wall through the temperature range 20 to 300°C (70 to 575°F). The extraordinary changes in length occurring in this interval, particularly at the flue end of the brick, can lead to very large internal stresses which may result in serious spalling. Between 200°C and 300°C (400 to 575°F) the danger is particularly great because of the changes taking place in cristobalite, as is well illustrated by Fig. 3.

Past experience has shown that the temperature at which this inversion occurs varies from sample to sample and even varies between heating and cooling curves taken on the same sample. These variations fall, however, within a limited range of temperature, namely, 200 to 275°C (392 to 527°F). While the change shown on the curve in Fig. 3 started at approximately 210°C (410°F) and was completed at 260°C (500°F), it is probable that another run on this sample or another set of samples would have given slightly different results. In general, one can say that the critical temperature range of rapid expansion or contraction will lie somewhere between 200°C and 290°C (400 to 555°F) and that on cooling, the inversion usually

takes place at a temperature 10 to 25°C lower than that at which it occurred on heating. The magnitude of the change remains nearly the same in all cases, even though the temperature varies a little.

Above 300°C (575°F) the expansion is not so great and becomes increasingly smaller as higher temperatures are reached. Moreover, the coefficient of expansion (slope of the curves in Fig. 3) is very nearly the same for all parts of the brick so that there is relatively little danger of spalling, even with rapid changes in temperature, while the brick is hot throughout.

While it is not possible to predict accurately the behavior of every brick in every position in the oven from the results obtained with a single brick, past experience and the results of the petrographic examination of a number of specimens justify the assumption that the data presented are fairly representative.

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EFFECT OF VARIOUS GASEOUS ATMOSPHERES ON THE VITRIFICATION OF CERAMIC BODIES*

By A. E. Badger

ABSTRACT

Various types of ceramic bodies were fired in atmospheres of O_2, N_2, CO_2, H_2, and H_2O. A marked increase in the rate of vitrification occurred when bodies containing feldspar were fired in an atmosphere of H_2O. This effect was explained on the basis of a feldspar-water eutectic.

I. Introduction

(1) Gases Present in Kiln Atmospheres

The rate at which a ceramic body matures is a function of the temperature and the duration of the heat treatment to which it is subjected and may be affected by the atmospheric conditions during the heating. Some of the time-temperature relationships which pertain to the vitrification of a typical porcelain body in air have been studied.[1]

A ceramic body during firing is subject to contact with water vapor, carbon dioxide, and sulfurous gases derived from the body itself and from the fuel used, along with oxygen and nitrogen from the air and, under reducing conditions, with carbon monoxide and small amounts of hydrogen and hydrocarbons. In the early stages of firing the concentrations of oxygen and nitrogen are high, due to the large amounts of excess air used, and considerable water vapor may be present from the evolution of mechanically held water in the body. In the range of low red heat the liberation of chemically combined water and the oxidation of carbonaceous material in the body increase the concentrations of water vapor and carbon dioxide. In the later stages of firing the amount of excess air is reduced to a minimum, and the concentration of carbon dioxide is greatly increased with decrease in the oxygen content. Reducing conditions may be used with the result that carbon monoxide and other combustible gases appear, usually in comparatively small amounts. The effect of reducing conditions in promoting the fusion of ferruginous bodies is marked.

In porcelains the fusion of feldspar is the most important factor in the maturing of the body. The feldspar glass acts as a solvent for the clay and silica, gradually closing the pores due to the action of its surface tension, and cementing together undissolved particles in the mass. The rate at which the body vitrifies is dependent on the amount and the fluidity of the feldspar glass. The latter quality is a function of the temperature but it is also affected by the presence of impurities in the body.

The solubility of gases in glass is well known from the investigations of Washburn[2] and others.[3] The subject of this investigation is the extent to which such gases, derived from the furnace atmosphere in which porcelain or other ceramic bodies are heated, might affect their rates of vitrification.

(2) General Plan of Investigation

In order to compare the effects of various gases on the rates of vitrification of ceramic bodies, test pieces of each body were heated to the same

* Received August 5, 1932.

[1] C. W. Parmelee and A. E. Badger, *Ind. Eng. Chem.*, **22**, 781 (1930).

[2] E. W. Washburn, F. F. Footitt, and E. N. Bunting, Univ. Ill. Eng. Expt. Sta., *Bull.*, No. 118 (1920).

[3] *e.g.*, A. Becker and H. Salmang, *Glastech. Ber.*, **6**, 625 (1929).

extent in the desired gaseous environment. The degree of maturity which was produced by the heat treatment was then judged by a determination of the apparent porosity of the fired body, as measured by the usual method of hydrostatic weighing, using kerosene as an immersion liquid.

The gases which were chosen for the tests were those to which the greatest significance is attached in commercial firing practice, *viz.*, oxygen, nitrogen, hydrogen, carbon dioxide, and water vapor. Ceramic bodies of compositions which are encountered in commercial work were used.

II. Methods of Firing Ceramic Bodies in Various Atmospheres

(1) Tests in Platinum-Wound Tube Furnace For the first tests a porcelain body of the following composition was chosen:

Composition of Porcelain Body B1

M & M ivory fat ball clay	20%	Feldspar	30%
A1 English china clay	30%	Flint	20%

The method of firing this body in various gases consisted in placing the sample in an impervious tube through which the test gas could be passed. This tube extended through a platinum-wound tube furnace, the temperature of which was controlled by suitable rheostats. The porcelain samples were in the shape of cylindrical rods, about one-half inch in diameter, which had been formed by extrusion through a die.

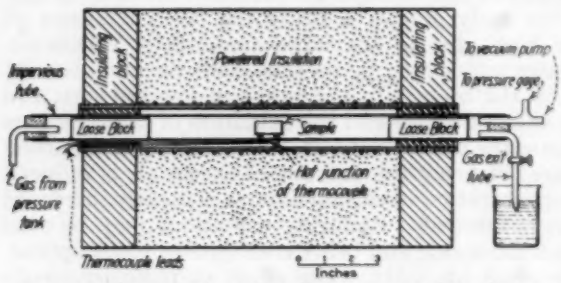

FIG. 1.—Cross-section of platinum-wound tube furnace arranged for heating porcelain samples in various gaseous atmospheres.

The test specimens were made of short lengths (about one inch) in order that they be at a practically uniform temperature during the firing treatment, as was proved by an exploration of the temperatures existing in the furnace interior. The samples were supported on a small frame of Alundum pipe stem which held them near the axis of the tube and permitted free play of the shrinkage forces resulting from the heat treatment. The temperature of the furnace was measured by a Pt Pt-Rh thermocouple which was affixed to the outside of the tube at a position midway between the ends of the sample. This thermocouple did not indicate the exact temperature of the sample, but the latter value was not required since the desired data were applied to the comparative action of the test gases. The temperature difference, however, between the thermocouple and a standard thermocouple which was substituted for the sample was found to be only 7°C at an indicated temperature of 1170°C. The variations in this temperature drop which were produced by the different gases should be negligible, since only a small stream of gas was used in each case. The experimental arrangements are illustrated in Fig. 1.

The tube containing the test specimen was exhausted by connection to a vacuum pump and was flushed out with the test gas several times. A gentle stream of gas was then allowed to flow through the tube during the test period. The gases were of the commercial purity obtained from steel

TABLE I

COMPARISON OF ACTION OF VARIOUS GASEOUS ATMOSPHERES ON VITRIFICATION OF PORCELAIN

(Fired according to Figure 2)

Body No.	Type of body	Dry weight (grams)	Apparent porosity Initial (%)	Apparent porosity Final (%)	Decrease in apparent porosity (%)	Gaseous atmosphere
B1	Porcelain	4.451	36.28	33.15	3.13	O_2
"	"	4.425	36.28	33.10	3.18	N_2
"	"	4.457	36.25	32.87	3.38	CO_2
"	"	4.563	36.25	32.41	3.84	H_2
"	"	4.463	36.28	27.26	9.02	H_2O

cylinders of compressed gas, except in the case of water vapor where a small flask was used as a steam generator.

The various test specimens were taken from adjacent sections of rod so as to have as nearly as possible the same physical condition. The furnace was heated on the same temperature schedule with the various test gases, and the degrees of vitrification of the samples were then compared by means of their apparent porosities.

Table I gives the results of the apparent porosity measurements, the dry weights being recorded in order to afford estimates of the size of the samples. The initial porosities apply to measurements which were made on the samples after they had been heated in air to about 750°C for several hours in order to oxidize any organic material and to drive off chemically bound water. This preliminary heating was necessary in order to produce specimens which would not change in chemical composition during the test runs.

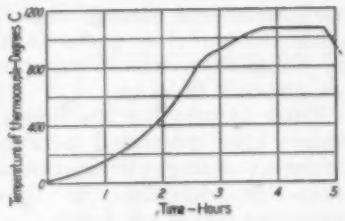

FIG. 2.—Graph showing heat treatment of porcelain body B1 in platinum-wound tube furnace through which various gases were passed.

Minor differences in the decreases in apparent porosities which are shown in Table I must be ignored, since it was impossible to duplicate exactly the heat treatments accorded to the various samples.

The results were confirmed by similar tests which indicated that within experimental error, oxygen, nitrogen, and carbon dioxide produced approximately the same effects on the rate of vitrification. Hydrogen increased the rate somewhat. The increase in vitrification in the presence of hydrogen was probably due mainly to the reduction of the small amount of iron oxide in the body which was evidenced by the black discoloration of the test pieces. A pronounced effect of steam in hastening the vitrification of the body is evident, the magnitude of this change being far beyond any possible experimental error.

The heat treatment which was applied to these samples was purposely

made insufficient to produce maturity in the bodies in order that the smaller porosity changes could show differences caused by the presence of the various gases. The heating curve is shown in Fig. 2. The variations from this standard heating curve were of the order of ±2°C in the vitrification range. The ordinates apply to readings of the thermocouple which was attached to the outside of the tube through which the gas stream flowed.

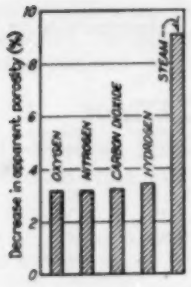

FIG. 3.—Comparison of the effects of various gases on the vitrification of porcelain.

The extent of maturity of the test specimens, as measured by the decrease in the apparent porosity, is shown graphically in Fig. 3, which utilizes the values of Table I. The acceleration in the rate of vitrification of porcelain which was produced by the presence of water vapor is evident from this figure.

The foregoing tests were performed at a temperature low enough to preclude the attainment of maturity of the porcelain body. It was deemed of interest to verify the pronounced action of water vapor by comparing its effect with that produced by a normally acting gas such as oxygen. The heat treatment was intensified in order to cause the body to approach maturity.

The tests were made on porcelain bodies having the same composition as body B1. The new body (B12), however, had been ground somewhat longer before blunging than had body B1, and hence the apparent porosities of these bodies were somewhat different.

The heating curve of body B12 is depicted in Fig. 4. The heat treatment was sufficient to produce an apparent porosity of 1.86% in the case of the steam-treated sample, but 7.52% apparent porosity existed in the oxygen-treated specimen.

A repetition of these tests on body B1 using the somewhat longer heat treatment exemplified by Fig. 5 again showed the pronounced increase in vitrification which was produced by the presence of steam.

Table II provides a summary of these tests. The intensified action of water vapor in aiding vitrification is evident from the decreases in the apparent porosities which are listed.

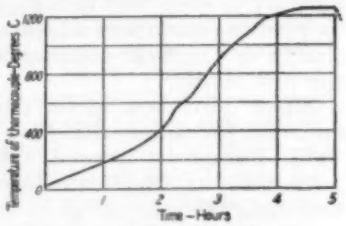

FIG. 4.—Graph showing heat treatment of porcelain body B12 in oxygen and in water vapor.

It seems probable that the increased rate of vitrification which was evidenced by steam-treated bodies was caused by the increased fluidity of the feldspar. The greater fluidity facilitated the cementing action of the feldspar glass upon those body constituents of higher melting points. Another possibility is that the presence of water vapor may promote chemical reactions in the mass.

The decreased viscosity of feldspar which is heated in steam was illustrated by heating small pyramids of feldspar in steam and in oxygen. The heating was continued until the surface of the steam-treated sample possessed a vitreous sheen. A pyramid which was similarly heat treated

in oxygen gas showed only a dull reflecting surface. These results seem to indicate that the fluidity of the feldspar glass was increased by the presence of water vapor.

TABLE II

COMPARISON OF PORCELAIN BODIES WHEN HEATED IN OXYGEN AND IN WATER VAPOR

Body No.	Firing treatment	Dry weight (grams)	Apparent Porosity Initial (%)	Final (%)	Decrease in apparent porosity (%)	Gaseous atmosphere
B12	See Fig. 4	8.973	36.95	10.85	26.10	Oxygen
		8.854	37.02	1.86	35.16	Steam
B1	See Fig. 5	9.318	37.02	7.52	29.50	Oxygen
		9.247	36.92	1.40	35.52	Steam

(2) Comparison of Effects of Water Vapor and Ordinary Kiln Atmosphere with Different Bodies

To determine the relative effects of water vapor and an ordinary kiln atmosphere, several bodies of varied composition including a fire clay, two porcelains of different feldspar content, a sanitary ware body, and a stoneware clay were selected. The porcelain bodies had the following compositions:

Composition of Porcelain Body D1	(%)	Composition of Porcelain Body C48	(%)
S. G. P. ball clay	20	S. G. P. ball clay	20
A1 English china clay	30	A1 English china clay	30
Feldspar	30	Feldspar	20
Flint	20	Flint	30

Duplicate test pieces of these bodies were placed in glazed crucibles which were set horizontally side by side in a gas-fired muffle furnace of the surface-combustion type. The crucibles were closed with refractory stoppers. A refractory tube was inserted through the stopper of one crucible, and water was fed in a small stream into this tube during the firing, where it vaporized to furnish a steam atmosphere. Uniformity of heat treatment of the two sets of samples was indicated by pyrometric cones placed on top of each crucible, but small temperature differences were unavoidable.

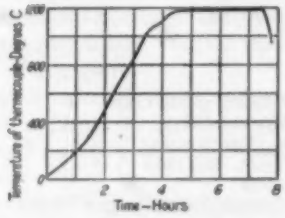

FIG. 5.—Graph showing heat treatment of porcelain body B1 in steam and in oxygen.

The results obtained with the different bodies are given in Table III, which shows that bodies containing feldspar are affected much more in their vitrification by an atmosphere containing water vapor than are the refractory and stoneware bodies.

(3) Tests on Feldspar Bodies in an Oil-Fired Kiln

The previous tests of the effect of gases on the firing of ceramic bodies had been made in furnaces of laboratory dimensions. The advisability of performing tests on a larger scale was indicated by the success of the small scale firings. Accordingly, comparative tests were made in a large oil-fired kiln.

Two round saggers, twelve inches in diameter and nine inches high, were used to hold duplicate samples of four different ceramic bodies, ten pieces of each body being placed in each sagger. The saggers were sealed with wad clay and placed as symmetrically as possible in the kiln in order that the samples should receive the same heat treatment. Pyrometric cones were placed on top and also inside of the saggers.

A hole was drilled through the side of one of the saggers, and a fused

TABLE III

COMPARISON OF VITRIFICATION OF VARIOUS CERAMIC BODIES IN STEAM AND IN THE ORDINARY FURNACE ATMOSPHERE WHEN HEATED TO CONE 7

Type of body	Dry weight (grams)	Gaseous atmosphere	Apparent porosity (%)	Difference in apparent porosity (%)
Porcelain body D1	9.258	Air	8.54	
	9.205	Steam	5.91	2.63
Porcelain body C48	10.051	Air	14.28	
	9.620	Steam	11.99	2.29
Sanitary ware	60.158	Air	2.39	
	53.399	Steam	1.24	1.15
Refractory brick (Goose Lake)	50.427	Air	21.56	
	64.675	Steam	20.99	0.57
Stoneware (Uhl)	32.358	Air	15.54	
	37.141	Steam	15.64	−0.10

silica tube was passed through this hole in such a manner that one open end extended to the middle of the sagger, while the other end passed through the kiln wall and was connected to a water-supply bottle. A slow trickle of water was allowed to pass down the tube when desired. The vaporization of this water produced a flow of steam into the sagger and the excess escaped through any crevices which were present. Thus, although the partial pressure of steam was unknown, it probably ap-

TABLE IV

COMPOSITIONS OF FELDSPAR BODIES USED IN LARGER SCALE TESTS IN OIL-FIRED KILN

	Electrical porcelain body (%)	Sanitary ware body (%)	Vitreous floor tile body (%)	Semivitreous ware body (%)
English china clay	30	26	20	30
Fla. kaolin		8	15	
N. Car. kaolin				9
Tenn. ball clay	20	10		13
Flint	20	30	15	36
Buckingham feldspar	30	26	50	12
Normal maturing temp.	Cones 9–12	Cones 9–11	Cone 9	Cones 9–11

proached one atmosphere. These furnace arrangements provided a method of heat treating a large number of samples to the same extent and afforded a direct comparison between the effects produced by steam and the ordinary kiln atmosphere.

All of the bodies which were chosen for this test contained some feldspar, but were of varied types, *viz.*, electrical porcelain, sanitary ware, vitreous floor tile, and a semivitreous body. The compositions of these bodies and their normal maturing temperatures are given in Table IV. In order to differentiate between the action of the steam-treated and normally

fired bodies, it was decided to fire the bodies to an extent insufficient to cause maturity of the bodies, *i.e.*, to cones 6 or 7.

Each body was blunged, aged a few days, and wedged carefully to remove gas inclusions. Samples of each body were then extruded through a die, each specimen being about three inches long and having a one-inch square cross-section. Ten samples of each body were chosen and placed in the test saggers. The kiln was then fired according to the schedule shown in Fig. 6. No water vapor was introduced into the steam-treated sagger during the early stages of the firing, in order to insure oxidation of the carbonaceous materials in the body. The steam was injected into the sagger when a temperature of about 850°C was reached, and the flow was continued during the remainder of the firing through the cooling stage until the temperature had dropped to about 750°C. During this interval about five and one-half liters of water were introduced into this sagger.

The appearance of the pyrometric cones when the kiln was drawn indicated that some temperature variation existed among the various samples, parts of the saggers being fired to cone 6 and other parts to cone $6^1/_2$, this difference being equivalent to about 10°C.

The appearance of the bodies which had been fired in steam was the same as that of the normally treated specimens, with the exception of the electrical porcelain body which had a more pinkish tint when fired normally than when fired in steam.

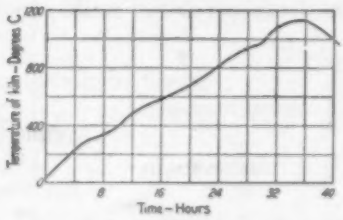

FIG. 6.—Graph showing firing schedule of the oil-fired kiln used in the larger scale tests.

Table V affords a comparison of the apparent porosities of the test specimens. Due to some variation in temperature within the saggers, the individual measurements of the porosities would not be expected to have the concordance which results from experiments on a laboratory scale. The values in Table V substantiate the fact that the presence of water vapor in the atmosphere surrounding a body which contains feldspar aids in the attainment of maturity of the ware.

Although the presence of water vapor influences markedly the apparent porosity of the ware, this change could not be noticed by microscopic examination. Thin sections of the bodies exhibited no apparent difference in the character of the undissolved quartz grains.

In addition to the ceramic bodies which were placed in the twin saggers, samples of feldspar (Buckingham) were included. From the last item in Table V it is evident that water vapor aided in the fusion of feldspar, the apparent porosities of the steam-treated feldspar being 5.34% and that of the normally fired feldspar being 16.90%. This result substantiates the previous tests on the vitrification of feldspar which were made in the platinum-wound tube furnace.

Since many pyrometric cones contain feldspar, it seems likely that such cones would deform at a lower temperature if notable quantities of water vapor were present in the atmosphere surrounding them. Unfortunately, no conclusions regarding this matter can be drawn from this test since the temperature variations within the kiln were too great for precise results.

(4) Additional Tests Using Aluminum Hydroxide as a Source of Steam

The efficacy of water vapor in aiding the vitrification of those bodies which contain appreciable feldspar suggests that commercial firing practice might be benefited by the use of a water-vapor atmosphere surrounding the test pieces. The

TABLE V

COMPARISON OF THE APPARENT POROSITIES OF CERAMIC BODIES WHEN FIRED* IN THE ORDINARY KILN ATMOSPHERE OR IN AN ATMOSPHERE SURCHARGED WITH WATER VAPOR

Type of body	Apparent porosity after firing: In kiln atmosphere (%)	Apparent porosity after firing: In H_2O atmosphere (%)
Electrical porcelain	4.57	1.61
	4.79	3.08
	5.69	2.28
	6.20	2.54
	7.19	1.40
	5.59	2.43
	4.89	1.05
	7.12	1.43
	5.90	2.77
	5.40	0.86
	Mean 5.73	Mean 1.95
Sanitary ware	13.46	8.04
	13.60	6.91
	13.70	8.12
	13.96	8.42
	13.36	6.82
	13.60	9.26
	12.90	9.88
	13.52	8.28
	13.90	6.79
	13.10	7.50
	Mean 13.61	Mean 8.00
Vitreous floor tile	0.69	0.22
	0.90	0.25
	0.90	0.16
	2.01	0.20
	0.71	0.17
	0.26	0.16
	0.80	0.16
	1.42	0.16
	0.44	0.17
	0.42	
	Mean 0.86	Mean 0.18
Semivitreous	23.51	23.26
	24.70	20.90
	24.91	21.32
	24.51	21.43
	25.75	21.03
	24.51	19.40
	23.90	20.80
	24.72	20.84
	24.57	20.46
		20.71
	Mean 24.57	Mean 21.02
Pure feldspar (Buckingham)	16.90	5.43

* According to Fig. 6.

greater fluidity of feldspar-water mixtures would result in a more limited range of heat treatment for vitrification, but this would not be a great obstacle.

The method of producing a water-vapor atmosphere in a commercial kiln is not evident. If steam were injected directly into the fire boxes, the loss in fuel efficiency resulting from the energy required to heat the large mass of water vapor which would be required would probably obviate any advantages which might result from a shorter firing time.

A fairly small amount of water, however, would suffice if the water vapor could be kept quiescent, as in a closed sagger or muffle. The previous test accomplished this, but such an arrangement would not be practical in commercial kilns.

If a cheap substance were available which would liberate H_2O at a high temperature, it might be placed in the saggers with the ware and act as a generator of water vapor. Although much of this vapor would be lost by diffusion through the sagger walls and cracks therein, sufficient concentration of water might exist to affect the vitrification of the ware.

The method used in the following test depends upon the property of aluminum hydroxide to retain one molecule of water up to a red heat. In making the tests, duplicate specimens were placed in two saggers. In

TABLE VI

COMPARISON TEST USING $Al(OH)_3$ AS SOURCE OF STEAM

Body	Dry weight (grams)	Atmosphere produced by	Apparent porosity after firing (%)
Porcelain	9.990	Kiln	6.32
Body D1	9.801	$Al(OH)_3$	3.87

the bottom of one of these saggers a quantity of $Al(OH)_3$ was placed. The dissociation of this compound should result in an evolution of steam at a temperature near the vitrification range of porcelain, and sufficient vapor might be retained in the sagger to affect the vitrification of the body.

Table VI shows that this supposition was correct, the apparent porosities of those samples which were heated with aluminum hydroxide being appreciably lower than those of the comparison samples. These tests were carried out in a large oil-fired kiln in which the temperature distribution was quite uniform.

(5) Addendum It is likely that interesting results might be obtained if glazed bodies were heated in a water-vapor atmosphere. The presence of water should lower the viscosity of the glaze and increase the tendency toward the formation of crystalline glazes.

III. The Effect of Dissolved Gases in Various Glasses

(1) Dissolved Gases in Rock Magmas The pronounced effect of water vapor on the fluidity of ceramic bodies which contain feldspar has an analogue in natural phenomena. It is well-known that rock magmas contain volatile constituents. Volcanic disturbances are accompanied by tremendous quantities of gaseous emanations, and water vapor constitutes more than 99% of the volcanic gases.[4] Although much of the steam which issues from volcanic vents

[4] F. W. Clarke, "The Data of Geochemistry," U. S. Geol. Surv., *Bull.*, No. 685, ed. 4, p. 255 (1920).

has been formed by rock decomposition,[5] some of it exists in solution in the molten magma. As the magma issues to the surface of the earth, the lowered pressure results in the evolution of most of the dissolved water vapor with the formation of a pumiceous mass.

That the presence of water in magmas has a lowering effect on the melting point is shown by the observation of Barus[6] that obsidian in the presence of water fused at about 1250°C while the resulting pumice melted at 1650°C.

The lowered viscosity induced in rocks by the presence of water vapor is illustrated further in the crystallization of rock magmas.[7] Those magmas which contained more dissolved gases were more fluid and permitted the molecular orientation which resulted in crystalline formations rather than the glassy condition which resulted on the cooling of the more viscous magmas which contained little gas in solution.

(2) Action of Water Vapor on Glasses

The above geological phenomena have a corollary in the action of water vapor on feldspar. Since the crystalline components which are present in a porcelain body are cemented together by an igneous feldspathic cement, it would be expected that the presence of water vapor would assist in the vitrification and maturing of the body. This effect has been shown to exist in the foregoing account. Since the quantity of gas dissolved by a liquid (as water vapor in molten feldspar) is proportional to the pressure the conditions in these experiments resulted in only small amounts of gas solution as compared with geological phenomena. A certain amount of solution would be expected, however, and that the amount of solute is not inappreciable has been shown by Washburn,[8] who found that silicate glasses contained from 0.2 to 2 times their volumes of dissolved gases (N.T.P.).

Another observation on the presence of water vapor in glass is noteworthy, namely, that glass batches which contain a small per cent of moisture melt up more easily than do the equivalent dry batches.[9] This observation seems to indicate that melts which are formed from moist batches possess a greater fluidity at high temperatures than do the corresponding dry melts.

The effect of water vapor on silicate melts is also shown by the equilibrium diagram[10] for the binary system of H_2O and K_2SiO_3, the melting point of such mixtures falling from about 976°C for pure K_2SiO_3 to 200°C for the compound $K_2SiO_3 \cdot H_2O$.

In the case of feldspar melts, the presence of water vapor should act in a similar manner, as mentioned by Bowen.[11] Although the pressures required to hold a given amount of H_2O in solution would probably be higher, still a certain amount would exist in solution at atmospheric pressure and cause appreciable lowering of the melting point. The action

[5] F. W. Clarke, "The Data of Geochemistry," U. S. Geol. Survey, *Bull.*, No. 685, ed. 4, p. 281 (1920).

[6] C. Barus, *Amer. Jour. Sci.*, **9**, 161 (1900).

[7] J. P. Iddings, Igneous Rocks, ed. 2, Vol. 1, p. 185, Wiley, New York (1920).

[8] See footnote 2, p. 107.

[9] E. M. Firth, F. W. Hodkin, M. Parkin, and W. E. S. Turner, *Jour. Soc. Glass Tech.* (Trans.), **10**, 220 (1926).

[10] G. W. Morey and C. N. Fenner, *Jour. Amer. Chem. Soc.*, **39**, 1207 (1917).

[11] N. L. Bowen, The Evolution of the Igneous Rocks, p. 289, Princeton Univ. Press (1928).

of H_2O in accelerating the vitrification of feldspar bodies is not mysterious in this light. Indeed, if such bodies could be heated under higher pressures of water vapor, the lowering of the maturing temperature would become much more pronounced.

If the amount of H_2O dissolved in the feldspar glass is comparable with that found to exist in commercial glasses, it would be difficult to measure by gravimetric methods. In one experiment about 5.5 grams of potash feldspar were placed in a platinum crucible and heated to 1275° in order to sinter the feldspar powder. A current of steam was then passed through the furnace chamber, and the feldspar was treated in this high temperature atmosphere for about $1^1/_2$ hours in order to surcharge the feldspar glass with H_2O. The furnace was then cooled to about 725°C, at which temperature the ordinary atmosphere of air was allowed to displace the steam. The crucible and contents were weighed after cooling to room temperature.

The crucible was then placed in a partial vacuum and reheated to about the same temperature, in order to expel any dissolved H_2O. The weight of the crucible after this treatment was unchanged within the limits of experimental error, and the quantity of H_2O in solution could not be determined in this manner.

IV. Summary

(1) The Presence of Water Vapor as an Aid in Maturing Feldspar Bodies

A study of the effects which are produced by various gases which are present in kiln atmospheres showed that water vapor accelerates in a marked manner the rate of vitrification of those ceramic bodies which contain notable amounts of feldspar. The increased rate is probably due to the lowered viscosity of the feldspar, which is produced by the solution of H_2O in the feldspathic glass. The presence of the gases, O_2, N_2, CO_2, and H_2, does not produce changes in the rate of vitrification which are readily distinguishable.

Acknowledgment This investigation is a contribution of the Engineering Experiment Station of the University of Illinois, of which M. S. Ketchum is the Director. The experimental work was carried out in the Department of Ceramic Engineering with the permission of C. W. Parmelee, Head of the Department. Consultations with R. K. Hursh, Professor of Ceramic Engineering, were made frequently during the course of the experiments and appreciation is expressed for his advice, as well as for the aid rendered by Abde Ally and W. H. Horak, students in the department.

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MODERN WASTE-HEAT TUNNEL DRIERS*

By T. W. Garve

ABSTRACT

The use of driers utilizing all waste heat available from kiln firing and cooling is advocated. Faults of waste-heat tunnel driers in reference to the manner of heat application are eliminated by original methods reaching the vital points, which are incorporated in driers of the following types: (1) hot air (waste heat) from top, combustion gas from bottom (optional); (2) hot air (waste heat) from bottom, combustion gas from bottom; and (3) hot air (waste heat) from bottom.

I. Introduction

Modern economy demands elimination or utilization of waste. In the clay industry there is ordinarily a great quantity of waste heat available from kilns and on its utilization has been focused, during the past few decades, the interest of competent engineers and clayworkers. Criticism which has been voiced during the last decade refers mainly to the improper manner of application and it is here that improvements are greatly needed. There have been numerous publications on faulty waste-heat driers but practical designs have not been presented which have alleviated the shortcomings as far as the author can learn.

The present driers are the outcome of experience and study and while the characteristics may not seem very revolutionary, they unquestionably can claim to fill vital needs. In times to come there will be improvements over the driers of today just as the driers of twenty-five years ago have long been outmoded. The writer has passed through such observation and experience.

II. "Wet Spot" *vs.* Drying Time

Every clayworker knows that the part comprising the center and bottom of the ware on the drier car dries last (just as any piece of wet clay). This "wet spot" determines the drying time and efficiency of a drier.

Figure 1 shows a cross-section through the lower part of a tunnel combining several methods to bring out the distance of the source of heat from the wet spot. The lower curved radiator applies to a conventional radiated-heat drier showing the average distance of the sloping radiator from the wet spot. In a few radiated-heat driers of more recent design the radiator is flat and placed about in line with the rail flanges. In the driers discussed herein, the radiator extends up to the car axle with enough clearance for passage of the cars. The rail ties through the duct are eliminated making each tie carry one rail of two adjacent tracks. If in this case the distance from the top of the radiator to the bottom of the wet spot is d, then this distance is nearly two times d on radiator plates along the rail flange and over three times d for the average distance of the conventional radiated-heat drier. The proximity of the radiator is essential. There is a quick increase in heat as we approach a fireplace or put our hand close to a room radiator. Where hot air (waste heat) is applied the flue outlet is placed, by means of two adjustable structural angles, directly below the car axles as shown dotted. It is evident that the source of heat has been placed as close to the wet spot as conditions will permit.

* For the Annual Meeting, American Ceramic Society, Pittsburgh, Pa., February, 1933.

III. Hot-Air Drier (Waste Heat) and Combustion Gas Optional

The attack of the wet spot from above is shown in Fig. 2, which is a cross-section through a tunnel of drier No. 1. It is a hot-air (waste-heat) drier, either with or without the application of combustion gases. The hot air is blown down through the ware and, after its passage through the ware, is permitted to pass around the lower edges of side aprons into narrow vertical side ducts and from here into two upper horizontal ducts beside the hot-air intake duct. These two upper ducts later join hands leading to a cross-flue connected with the stack as shown in Fig. 3. The vertical side ducts are staggered, resulting in left-hand and right-hand cross-currents through the ware, *i.e.*, through the wet spots of single-deck or double-deck cars. The same result may be obtained by using continuous side aprons and closing the lower intakes alternately in sections.

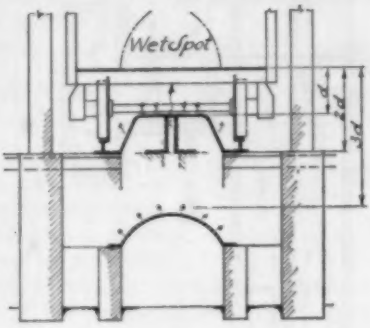

FIG. 1.

Short circuiting is impossible since the air from the top is introduced under pressure and all bottom inlets to the vertical ducts are properly proportioned in size (by equalization tables) to obtain equal distribution and maintain a pressure within the drying tunnel. The partitions are of "transite" or similar material and are easily placed within the tunnels. The circulation is within the ware and all conveyance of incoming hot air and outgoing warm air is done in proximity to the ware within masonry walls and an insulated roof. The vertical ducts shown are merely illustrative and their number can be increased.

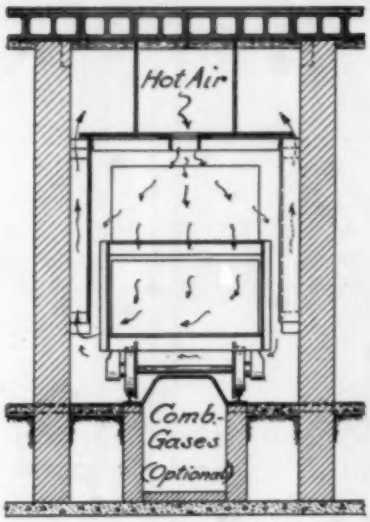

FIG. 2.

If the drier has additional combustion gas flues (marked "optional"), the latter are leading to an underground cross-flue connecting with the previously mentioned stack.

This drier is excellent for drain tile and hollow ware, the current of hot air being caught within the ware on its downward path. It is also adaptable for brick and other ware since, while the bulk of the heat will pass through the setting, a smaller part will get to the outside of the setting as it should. The width of the top outlets can be varied to suit the character of the ware by small adjustable angles or other means.

The introduction of the air from the top has advantages over the bottom

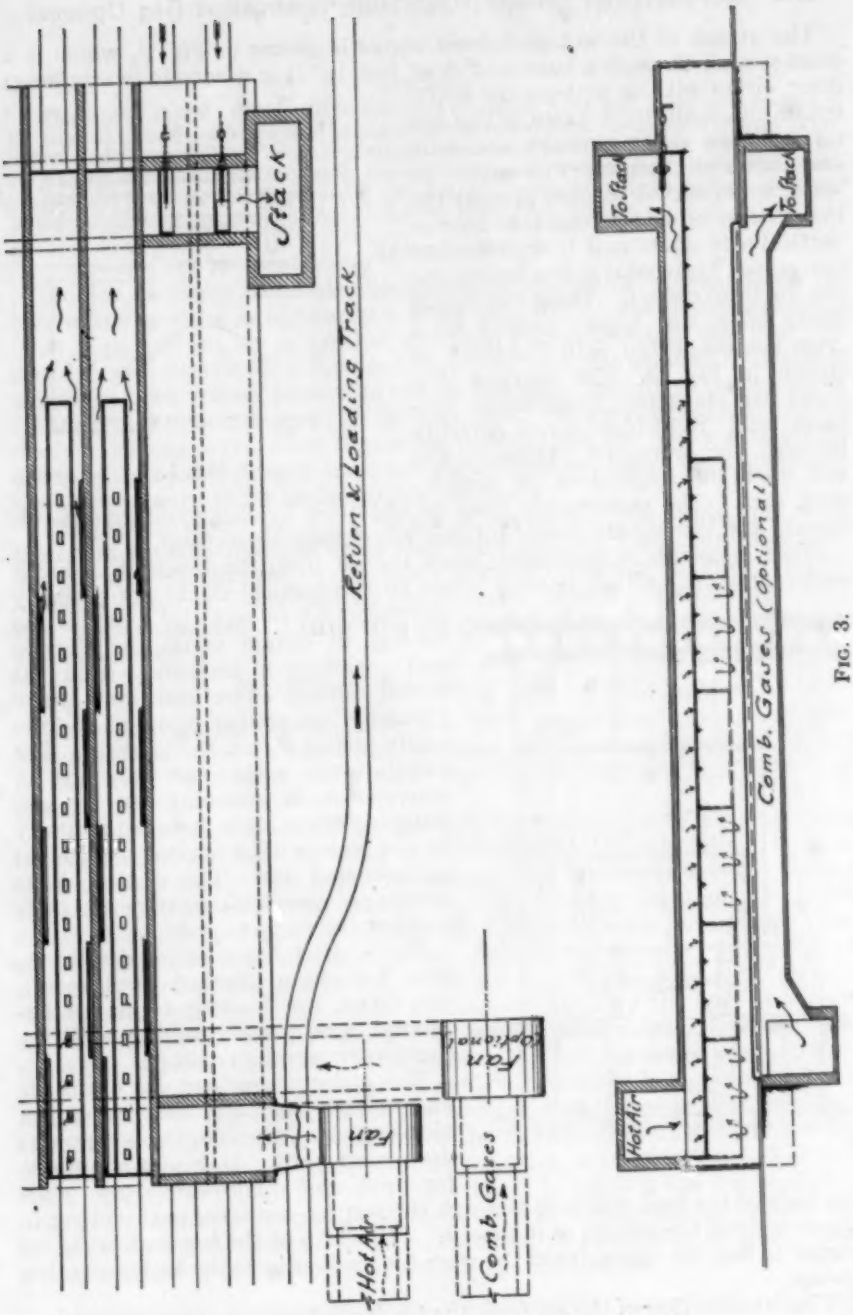
Track
Return & Loading Track
Fan
Hot Air
Comb. Gases
Fan
Comb. Gases (Optional)
To Rack
To Rack
Hot Air

FIG. 3.

introduction where car bottoms are fairly tight due to wide slats or solid pallets (for large drain tile, etc.). Such tight bottoms act like baffles, deflecting the air and forcing it around the wet spot, which should be avoided. It is a drier also adaptable for drying ware on kiln cars. The introduction of the hot air from the top has the additional advantage that the underground combustion gas feature can be added to the drier at any time without interference.

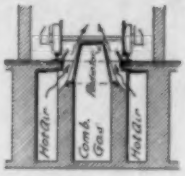

FIG. 4.

IV. Hot-Air Drier (Waste Heat) and Combustion Gas from Bottom

Since conditions vary greatly in the clay industry, it is often advisable to introduce the hot air as well as the combustion gases from below by an underground flue system. Figure 4 shows a solution of such a problem where the hot air, emerging from slots of two side flues, is blown against and along the sides of a large continuous radiator, moving directly toward the wet spot. A few radiated heat driers have been built in recent years with standard cast-iron pipes acting as radiators, which merit favorable comment, but it is evident that a radiated-heat drier in combination with hot-air current directed toward the wet spot is more effective. Indirect heat recovery is always inefficient unless large radiating surfaces are exposed and sufficient means of contact and air movement are provided. In this respect the old conventional radiated-heat drier is greatly lacking. To obtain the benefit of radiated heat alone, the drier must be operated very hot.

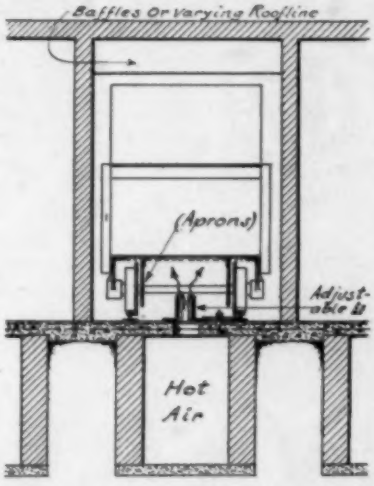

FIG. 5.

The author wishes to emphasize the fact that "waste-heat driers" and not "radiated-heat driers" are being presented here. Radiated-heat driers carry their independent source of heat, while the author is advocating the use of all waste heat available from the kiln or kilns.

V. Hot-Air Drier (Waste Heat) from Bottom

The last drier, shown in Figs. 5 and 6, is a hot-air (waste-heat) drier with heat application from below. There are no holes or short cross-slots under the cars. Such small individual outlets introduce resistance in the flues (power loss on one side and pressure loss on the other side). They are also cumbersome to adjust and may fill up.

In the very center below the cars there is a continuous longitudinal slot for the intake as well as for the outlet. A pair of structural angles are so placed as to obtain longitudinally tapered slots. These tapered slots are shown shaded in Fig. 6, first a fully tapered intake slot with the

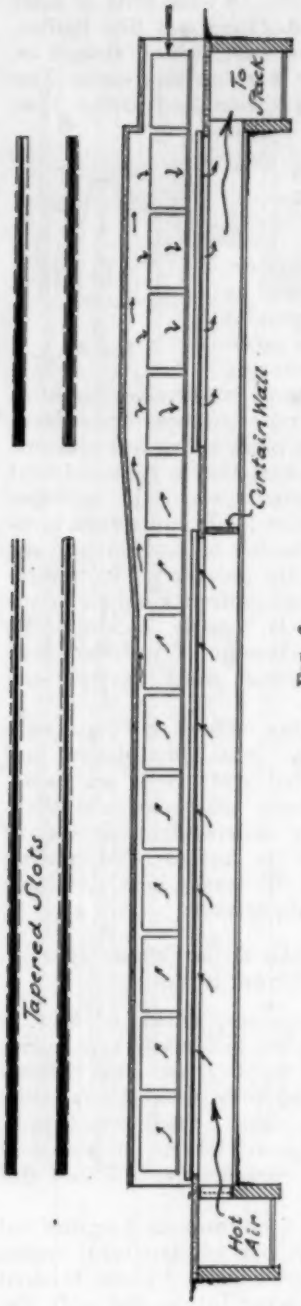

FIG. 6.

angles in one piece and below a partly tapered intake slot with each angle in two pieces. Adjustments are simple, since only one nut holding one clamp of one angle, located very near the end of the tunnel, needs to be manipulated and the end of this one angle can be shifted in or out to narrow or widen the slot all along the line. Since adjustments should always be made to maintain "shading off" or "gradually varying" conditions, the longitudinal tapered slot is the logical solution. The place where the heat escapes outside the grip of the angles has been placed as close to the wet spot as possible, *i.e.*, directly below the car axles, as was pointed out in connection with Fig. 1. This feature also applies to the incoming cars above the outlet slot.

With the additional feature of car aprons (see Fig. 5), as suggested by Mr. Lovejoy, the system approaches the sand seal used on tunnel kiln cars. These aprons are permanently attached to the cars and have slots to accommodate the car axles. The heat, tending to rise and emerging close to the wet spot, can not escape into the side spaces which is a big fault of the usual progressive tunnel drier. An occasional end apron is desirable to prevent horizontal draft under the cars.

Since drying should proceed rapidly after the initial stages of danger have passed, it is essential to carry the intake duct far into the tunnel. The curtain wall separating the intake end from the outlet end of these flues, shown in Fig. 6, may be placed farther in or out to lengthen or shorten the intake flue to suit the clay and the ware.

It should be noted that the top of the drier is depressed at the hot end and raised at the cold end to obtain updraft in one part and downdraft in the other part of each tunnel and to eliminate any tendency of short circuiting. On old driers with sufficient headroom, baffles may be used instead.

VI. Conclusions

A recapitulation of the three driers discussed involves the following points:

Drier No. I (Figs. 2 and 3). Introduction of hot air in center from top, avoiding baffling effect of car decks or pallets, and

reaching wet spot; additional alternating cross-currents through wet spot; circulation among ware and near ware; introduction of underground flues for use of combustion gases is optional.

Drier II (Fig. 4). Hot air (directly) and combustion gas (indirectly) applied through introduction from below; radiator close to wet spot; hot-air current passing over large radiator and directed toward wet spot; updraft at hot end of drier and downdraft at opposite end.

Drier III (Figs. 5 and 6). Hot air from below through angles forming tapered slot with emission in center of car and close to wet spot; very simple adjustment to obtaining perfect shading-off conditions; updraft at hot end of drier and downdraft at opposite end, addition of car aprons making escape of heat sideways practically impossible.

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Vol. 12 **February, 1933** **No. 2**

Abrasives

Preparing surfaces on lithographic plates. C. MASON WILLY. *Abrasive Ind.*, **13** [8], 16 (1932); for abstract see *Ceram. Abs.*, **11** [11], 547 (1932). E.P.R.

Efficiency of abrasives in working glass. JACQUES WOLF. *Glass Ind.*, **13** [12], 189–92 (1932).—Most mechanical abrasive working of glass is done with sand of varying grain size and pumice stone of various degrees of fineness, and in special work, emery and silicon carbide are employed. Grindstones of three classes, rotating disks, natural stones, and artificial products, play a prominent part in the mechanical working of glass. The hardness of a grindstone depends on various factors, (1) the nature of the abrasive, (2) grain size, (3) bond resistance, (4) distance between the grains, and (5) pore size. Applied technique affecting the output of the grindstone is considered from the standpoints of (*a*) matter to be treated, (*b*) kind of work, (*c*) method of working, (*d*) hand and automatic operation, (*e*) speed of rotation, (*f*) fitting up, (*g*) the upkeep, and (*h*) the wear. A full discussion of these points is presented. E.J.V.

Adhesion of glue and fused alumina abrasives. IV. HENRY R. POWER. *Metal Cleaning & Finishing*, **4** [11], 611–12 (1932).—Glue briquet tests for adhesiveness made on three types of abrasive, untreated, glossy type, and surface tenacity type, showed that the latter was superior both before and after exposure. This type of abrasive is also superior in capillarity tests. All three types are wet by liquid oil at about the same rate. For Part III see *Ceram. Abs.*, **11** [3], 146 (1932). E.J.V.

Longer service from costly machine shop tools. H. J. CHAMBERLAND. *Popular Sci. Monthly*, **120** [1], 90–92 (1932).—C. describes a grinding fixture for holding planer knives while being sharpened. Methods of grinding stellite and cemented tungsten-carbide tools are also described. Grinding wheels of the proper size, hardness, and grain size are included in each case. Illustrations and diagrams. F.G.H.

PATENTS

Universal drive for grinding machines, etc. ADOLPH STORM AND THOR THORSEN (Storm Mfg. Co., Inc.). U. S. 1,888,480, Nov. 22, 1932.

Method and means for dressing grindstones. W. N. BAKER AND R. A. MASTEN (International Paper Co.). U. S. 1,888,614, Nov. 22, 1932.

Grinding machine. WILLIAM ARTER AND W. F. FRASER (Arter Grinding Machine Co.). U. S. 1,888,710, Nov. 22, 1932. F. J. JESCHKE (Micromatic Hone Corp.). U. S. 1,889,664, Nov. 29, 1932. P. H. HUTCHINSON (General Motors Corp.). U. S. 1,890,854, Dec. 13, 1932.

Emery or abrading wheel. J. R. MITCHELL. U. S. 1,890,401, Dec. 6, 1932. A grinding wheel having radially spaced grinding members, has the inner side wall of one grinding member shaped to provide pockets to receive abrasive, the extreme inner edge portion of the side wall forming each pocket being hook-shaped and being projected forwardly.

Dressing tool. M. J. WALSH. U. S. 1,890,481, Dec. 13, 1932.

Buffing wheel. B. H. DIVINE. U. S. 1,890,502, Dec. 13, 1932.

[1] The abbreviation (*C.A.*) at the end of an abstract indicates that it was obtained from *Chemical Abstracts* by coöperative agreement.

The bold-face number following the journal name is the volume, the issue number is in brackets followed by the page numbers, then the year in parentheses.

Cylinder grinding and honing machine. L. J. DOERR AND J. J. DOERR (L. J. Doerr Motor Works Co.). U. S. 1,890,675, Dec. 13, 1932.

Grinding gage. F. J. PRATT. U. S. 1,890,827, Dec. 13, 1932.

Railway track grinder. HENRY PERAZZOLI. U. S. 1,891,173 and 1,891,174, Dec. 13, 1932.

Portable grinding or drilling machines, etc. W. G. ARMSTRONG, WHITWORTH & CO., LTD., AND T. C. REAVELY. Brit. 382,375, Nov. 2, 1932.

Cutlery grinding and polishing machines. B. WALTERS AND W. M. DOBSON. Brit. 382,408, Nov. 2, 1932.

Hydraulic feeds for machine tools, particularly for milling machines, grinding machines, etc. V. JERECZEK. Brit. 383,106, Nov. 16, 1932.

Cutting, grinding, or other treatment of stone, etc., where ball shot or like abrasive is employed. G. F., T., F. F. W., AND V. E. ATYEO. Brit. 383,282, Nov. 23, 1932.

Abrasive disks. A. H. STEVENS (Titan Abrasive Co.). Brit. 383,518, Nov. 23, 1932.

Precision grinding or abrading machines. CHURCHILL MACHINE TOOL CO., LTD., AND H. H. ASBRIDGE. Brit. 383,724, Nov. 30, 1932.

Art and Archeology

Art at Keewaydin, Vermont. ANON. *Amer. Mag. Art*, **25** [4], 242–43 (1932).—The Keewaydin Art Club, a chapter of the American Federation of Arts, is experimenting in art training at Keewaydin, a summer camp for boys on Lake Dunmore, Vt. A special studio for sculpture and pottery will be equipped. E.B.H.

Village school pottery. ANON. *Christian Sci. Mon.*, **25** [4], 8 (1932).—A brief description of the pottery being operated in connection with an art course at the school in Wessington, Derbyshire, England, is given. All the different operations are performed by the students at some time or other so that each is acquainted with each operation. E.J.V.

Art pottery manufacture on Catalina Island. ANON. *Popular Sci. Monthly*, **120** [5], 28 (1932).—Illustrated. F.G.H.

Wall treatments of plaster and ceramic tile. T. S. ROGERS. *Amer. Home*, **8** [5], 233–57 (1932).—The use of ceramic tile and textured plaster of various colors to match period furnishings is described. Illustrated. F.G.H.

Gold or silver patina on highly colored majolica glazes. F. THEILMANN. *Sprechsaal*, **65** [43], 773 (1932).—Pottery busts, vases, and other ceramic articles with an interesting and artistic finish may be produced by first applying a dark colored glaze and then firing in a thin coating of gold or silver, most of which is then scoured or polished away, but is left as a patina in the depressions. Hairlining of the ground glaze heightens the decorative effect. W.W.B.

Portraying the porcelain industry with porcelain statues. ANON. *Popular Sci. Monthly*, **120** [2], 63 (1932).—William Leber, a craftsman of Berlin, Germany, has completed an artistic series of porcelain figures which depict the manufacturing operations of the porcelain industry. Illustrated. F.G.H.

B. A. D. A. art treasures. F. GORDON ROE AND CHARLES R. BEARD. *Connoisseur*, **90** [374], 240–54 (1932).—The British Antique Dealers' Assn. held its Art Treasure's Exhibition from Oct. 5 to Nov. 5. Of ceramic interest were silver mounted stoneware jugs, some exquisite Sèvres vases, four cases of English porcelain, and two of pottery figures bearing such famous names as Ralph Wood, Astbury, and Whieldon, the Chinese families of the 17th and 18th Centuries, the "whole-colored" porcelain of pre-Ming ware, green, rose, and black. Illustrated. E.B.H.

Porcelain for Municipal Museum, Madrid. ANON. *Christian Sci. Mon.*, **24** [297], 7 (1932).—Over 600 pieces of old Spanish porcelain from the Buen Retiro factory, an attempt to establish an industrial art new to Spain in the 18th Century, have been presented to the Muncipal Museum in Madrid by Don Francisco de Laiglesia. A few of the rare pieces are described. E.J.V.

Tz'u Chou ware at the Freer Gallery of Art. ANON. *Connoisseur*, **90** [374], 284 (1932).—The Tz'u Chou ware is from the factories of southern China which have been in existence for 1300 years. The most common has a body of gray stoneware shading to reddish buff with a creamy white surface composed of a whitish slip and a transparent glaze. A design of black and brown is most prevalent, phoenix and scrolls being common motifs. Another typical motif is "sage in landscape." Illustrated. E.B.H.

Chinese tile reliefs in Pennsylvania Museum. ISABEL INGRAM. *Connoisseur*, **89** [369], 321–23 (1932).—The material used in this remnant of a pagoda frieze is the common gray clay of north China with earth and lime incrustation on some, while others have a smooth brown patina. Each tile holds in a depressed space a standing figure having beauty of body and line. They are attributed to the Sung dynasty because of their well-planned composition, the treatment of the figure with soft draperies, and the exclusion of superfluous detail. Illustrated. E.B.H.

Chinese enameled boxes. ANON. *Christian Sci. Mon.*, **24** [261], 7 (1932).—Some of the silver enameled boxes produced in China in the late 19th Century are briefly described. The decoration includes every type of enameling, walled, sunken, raised, and painted glazes. The enameling can not compare with the best enamels of Europe and India. E.J.V.

Chinese porcelain in England by 1570. ANON. *Christian Sci. Mon.*, **24** [273], 7 (1932).—Specimens of Chinese porcelain found marked with the date letter for the year 1569–1570 show that this material must have been introduced into England on or before that date. A description of some of the specimens is given. Illustrated. E.J.V.

Gulland Collection Exhibition. ANON. *Pottery & Glass Rec.*, **14** [10], 303 (1932).—A selection of Chinese porcelain from the Gulland collection is exhibited at the Victoria and Albert Museum, London. Most of the objects were made at the Imperial factories of Ching-te Chen and under the Manchu or Ch'ing dynasty in the 17th, 18th, and 19th Centuries, but among the earlier pieces there are examples of the Ming porcelain. The nucleus of the collection consists of "blue and white" ware painted in underglaze blue, each by a single hand. M.V.K.

Ostraka on pottery. ANON. *Times* [London], Aug. 29, 1932.—The American excavations of the agora at Athens have unearthed the shards on which the ostracism of Themistocles, Aristides, and Hipparchus are recorded. H.H.S.

Glass embossing. ANON. *Ind. Finishing Jour.*, **3** [34], 231 (1932).—Acid embossing is done with fluoric acid, a compound of sulfuric acid and fluorspar, which is a solvent of glass. The fluoric acid is kept in lead or gutta-percha containers sealed with wax or tallow to prevent the acid or its fumes from escaping. The process of etching or embossing varies slightly according to whether the glass to be treated is small enough to be dipped bodily into a bath of the acid. In either case the design is traced on the clear glass and a protective coating is applied to the parts which are not to be embossed. The coating is an acid-resisting paint (usually made with Brunswick black and some red lead). Details of the acid bath and further steps to be taken for obtaining a satisfactory etching are discussed. M.V.K.

Glass mosaics. JACQUES WOLF. *Rev. belge ind. verrières, céram., émail.*, **3** [1], 5–6; [2], 32–34 (1932).—W. presents an encyclopedic account of glass mosaics which includes (1) the development from stone to glass, (2) problems of design and color, and (3) technique of making glass cubes and their setting in the design. P.E.C.

Vitrifiable glass colors. CERAMIC COLOR & CHEMICAL MFG. CO. *Ceram. Ind.*, **19** [6], 298 (1932).—A new line of vitrifiable glass colors has been produced to be used on all types of glassware to obtain an unlimited number of pastel colors and brilliant hues. W.W.M.

Stained glass for the house. ANON. *Arch. Rec.*, **72** [5], 342–44 (1932).—Increasing informality is found in the use of stained glass for windows and interior motifs in country houses, the type being a contrast to the accepted versions of glass design. Illustrations show examples of glass painting, applied hand-cut lead, antique colored glass, and etched, various shades of flashed glass with lead outlines copper finished. E.B.H.

Art of stained glass in Ireland. PADRAIC COLUM AND JOHN DAVID. *Stained Glass*, **27** [11], 315–17 (1932).—The art of stained glass is the art of pattern in color to produce an emotional effect by transfused light. Light is of prime importance and the business of the glass artist is not to produce a transparent picture, but to make a window beautiful by using to the full its possibilities of light. The work of Sarah Purser, who founded a stained-glass industry in Dublin, is discussed. M.V.K.

Medieval stained glass in Cornwall and Brittany. GILBERT H. DOBLE. *Jour. Brit. Soc. Master Glass-Painters*, **4** [4], 183–86 (1932).—Cornwall possesses few medieval stained glass windows. St. Neot has a complete set of windows of painted glass of the 15th and 16th Centuries, which are described in detail. Fine windows of Rennes, Champeaux, and Dol, in Brittany, are also described. M.V.K.

Apparent decay of ancient glass at Wells Cathedral. ALEXANDER SCOTT. *Jour. Brit. Soc. Master Glass-Painters*, **4** [4], 171 (1932).—S. describes investigations made on

a 14th Century glass on the inside of which appeared a peculiar coating. An examination under the microscope and a quantitative chemical analysis showed it to consist of calcium sulfate in small nodules. It was found that the sulfuric acid was derived from the combustion of the gas used for lighting the cathedral. The lime was supplied from the floor which is paved with a soft fine-grained limestone. M.V.K.

Ancient stained glass of Alsace. J. CLEMENT BELL. *Jour. Brit. Soc. Master Glass-Painters*, **4** [4], 163–70 (1932).—B. describes highly artistic stained glass found in Alsatian churches. M.V.K.

China patterns for every purse. ANON. *Amer. Home*, **7** [4], 204–205 (1932).—Two pages show illustrations of American and European china. F.G.H.

China and glassware services. ANON. *Amer. Home*, **8** [6], 276–77 (1932).—Two illustrated pages of china and glassware are presented. F.G.H.

New glassware designs. ANON. *Amer. Home*, **7** [6], 341 (1932).—This is an illustrated page of new designs in glass tableware. F.G.H.

Modern French art glass. ANON. *Christian Sci. Mon.*, **24** [278], 6 (1932).—Baum, Décorchement, and other French artists are treating glassware much like pottery, in some instances making it almost massive in character, rather than fragile, delicate, and transparent, as is usual. Illustrated. E.J.V.

Walter Teaque designs typical American styles for Steuben glass tableware. STEUBEN GLASS WORKS. *Ceram. Ind.*, **19** [6], 283 (1932). W.W.M.

BOOKS

Etowah Papers: Ceramic Art of the Etowans. M. E. ASHLEY, *et al.* xi + 178 pp. Yale Univ. Press, New Haven, 1932. Price $5.50. Reviewed in *Times Lit. Supp.*, **31**, 624 (1932).—The Etowah Mounds in Georgia formed part of the Muskhogean culture area east of the Mississippi. H.H.S.

Ancient Stained and Painted Glass in Surrey Churches. ANON. Reviewed in *Jour. Brit. Soc. Master Glass-Painters*, **4** [4], 203–204 (1932).—This book, containing many plates in color, should be valuable to anyone interested in stained glass. M.V.K.

Trapuco: Cambridge Excavations in Minorca. I. M. A. MURRAY, *et al.* 50 pp. 52 plates. Bernard Quaritch, London, 1932. Price 12s 6d. Reviewed in *Times Lit. Supp.*, **31**, 644 (1932).—The pottery found is noteworthy as being the first discovery of any quantity in Minorca. H.H.S.

The Annals of Archaeology. Vol. XIX. Nos. 1 and 2. ANON. Univ. of Liverpool Press, 1932. Price 12s. Reviewed in *Discovery*, **13**, 304–305 (1932).—In Garstang's excavations at Jericho the pottery is of great interest. The dating of specimens by theory can now be abandoned. H.H.S.

Necrocorinthia: Study of Corinthian Art in the Archaic Period. HUMFRY PAYNE. Clarendon Press, Oxford, 1932. Price 4 guineas. Reviewed in *Times Lit. Supp.*, **31**, 622 (1932); see also *Ceram. Abs.*, **11** [4], 252 (1932). H.H.S.

Tell-el-Amarna. M. A. CHUBB. *Discovery*, **13**, 297–99 (1932).—The Egypt Exploration Society's expedition is described. See also *Ceram. Abs.*, **11** [1], 8; [8], 439 (1932). H.H.S.

PATENTS

Design for plate. YUKIO BUMA (Morimura Bros., Inc.). U. S. 88,286, Nov. 15, 1932.

Design for bottle. W. B. MARBLE (Latchford Glass Co.). U. S. 88,360, Nov. 22, 1932.

Design for tumbler, etc. I. M. CLARKE (New Martinsville Glass Mfg. Co.). U. S. 88,398, Nov. 29, 1932.

Decalcomania. P. W. MARSHBURN (Northam Warren Corp.). U. S. 1,889,484, Nov. 29, 1932.

Cements

Reaction between aluminous cement and water; a contribution to the theory of hardening. HANS KÜHL AND HANS BERCHEM. *Zement*, **21** [39], 547–53; [40], 561–67 (1932).—The reactions between aluminous cement and water were studied according to the method of Wang. The aluminate compounds of aluminous cements, essentially calcium aluminate, dissolve rapidly and easily. They are dissolved from cement grains, undergo a hydrolysis, and change into dicalcium hydroaluminate and aluminium hy-

droxide. Both new formations are first found in a colloidal solution; their separation proceeds extremely slowly. Even after the separation only delicate amorphous structures are present in which the dicalcium hydroaluminate gradually changes into the crystalline state with the formation of spherulite. Free hydrate of lime is formed in the liquid phase because of the hydrolysis of the raw material. The concentration of the limewater, however, remains very low; its p_H value is about 11.6 to 11.7. In the reaction liquid the solubility of the dicalcium hydroaluminate formed is rather high in comparison with the solubility of the hydration products of Portland cement in limewater. It corresponds to an alumina content of 164 mg. per liter in contrast with only 10 mg. in Portland cement. The silicate constituents, essentially dicalcium silicate, hydrate around and in the cement grains and form a jelly covering of calcium hydrosilicate whose constitution can not be determined. The appearance of the jelly covering slows down the reaction velocity because it prevents the further dissolving of the aluminate constituents in the interior of the cement grain. The hydration process does not stop, however, because water penetrates through the gel case into the interior. Because of this it is possible that with further hydration the aluminates hydrate also in the interior of the cement grains. The theories of Michaelis on the hydration processes occurring in Portland cement can also be utilized with small changes (because of the nature of the materials) in the hydration process of aluminous cement. Chemically, the question concerns a colloidal process; mechanically, it is a solidification of a gel mass through an "internal suction." M.V.K.

Manufacture of Portland cement. VIII. S. E. HUTTON. *Rock Prod.*, **35** [23], 12–13 (1932).—H. discusses the effects of the various components on the properties of Portland cement. The sources, functions, and effects due to silica, alumina, iron oxide, sulfur, magnesia, alkalis, manganese oxide, titanium, phosphorus, and carbon dioxide are given. For Parts VI and VII see *Ceram. Abs.*, **12** [1], 6 (1933). W.W.M.

Recast analysis and its relation to the chemistry of Portland cement. VII. LOUIS A. DAHL. *Rock Prod.*, **35** [24], 26–27 (1932).—D. continues his discussion of the course of crystallization of cement clinkers containing more than three components. The mathematical relation between the composition of the melt, the composition of the solid portion, and the composition of the mixture as a whole is shown. For Parts IV to VI see *Ceram. Abs.*, **12** [1], 6 (1933). W.W.M.

Theoretical and practical developments in Portland cement chemistry. II. Reactions leading to the formation of clinker in the kiln. HANS KÜHL. *Pit & Quarry*, **24** [10], 32–36 (1932); for Part I see *Ceram. Abs.*, **11** [11], 596 (1932); see also *ibid.*, **12** [1], **7** (1933). E.P.R

BOOK

Hardening of Cement. (Uber das Abbinden des Zementes.) H. GESSNER. 39 pp. Th. Steinkopff, Dresden and Leipzig, 1929. Reviewed in *Mineralog. petrog. Mitt.*, **41** [1], 104 (1931).—A critical review of the literature of the last six years on the colloidal theory of the hardening of cement is given. In the experimental part, studies are given of the change of viscosity in the cement paste during these reactions, as well as the change in electric conductivity, the swelling phenomena, and the aqueous vapor tension above the same mass. G.R.S.

Enamels

Method for determining the coefficient of expansion. C. J. KINZIE AND C. H. COMMONS, JR. *Jour. Amer. Ceram. Soc.*, **16** [1], 1–5 (1933).

Economical preparation and use of colored enamels. II. Use. R. L. FELLOWS. *Better Enameling*, **3** [11], 25–26 (1932).—F. emphasizes the importance of shop control and production processes in the use of colored enamels. He touches upon milling, spraying, and firing, including methods of firing several different colors. In no case should the workability of the enamel be sacrificed to obtain a certain color. For Part I see *Ceram. Abs.*, **12** [1], 8 (1933). W.W.M.

Calculating the expansion of cast iron and enamel. WALTER KERSTAN. *Glashütte*, **62** [45], 795–98 (1932).—It is necessary to know the approximate value of the coefficients of expansion to adjust the enamel on the metallic base. The attempts of Winkelmann and Schott, Mayer and Havas, and Turner to determine mathematically the coefficient of expansion are discussed. The absolute value of the coefficient of expansion of an enamel is not so important for practice as this relationship to the coefficient of expansion of the metallic base, and it is not sufficient to equalize the coefficients of expansion of both materials at room temperature to obtain an enamel coat

free from stresses. The knowledge of the whole course of expansion in the critical temperature regions, especially in the region where the viscous, melted enamel layer changes from the liquid state into the solid, brittle state is much more important. K. investigated by means of the Chevenard dilatometer the actual expansion of different kinds of cast iron and enamels. Tables show the calculated (according to Kent) and the measured values of the coefficients of expansion dependent on the temperature. The differences in the values calculated and those obtained experimentally are wide and show that the calculating method of Kent is of a hypothetical nature. See also *Ceram. Abs.*, **12** [1], 8 (1933). M.V.K.

Suggestions for enamels for heavy sheet-iron stock. ANON. *Ceram. Ind.*, **19** [6], 284 (1932).—The addition of quartz makes enamel more refractory and more suitable for heavy sheet-iron stock. Milling several kinds of ground coats together produces satisfactory cover for heavy iron sheets. Enamel for heavy iron sheets will work better if not smelted completely. W.W.M.

Enameled illuminating bodies. ANON. *Glashütte*, **62** [43], 743–45 (1932).—The manufacture of radiators, reflectors, and laboratory reflectors is described. Special care must be taken of the composition of the enamel and its properties because the luster and the color of the enamel are of the greatest importance for total reflection. Those values can not be determined by calculation, but through experiments made systematically. Several enamel compositions are discussed and analyzed. M.V.K.

Effect of temperature on ground-coat slips. HERMAN GILBERT. *Enamelist*, **10** [2], 12 (1932); for abstract see *Ceram. Abs.*, **11** [11], 555 (1932). W.W.M.

Enamel science. XXIII. PH. EYER. *Emailletech. Monats-Blätter*, **8** [11], 86 (1932).—E. gives compositions of a cast-iron ground coat frit, the mill batch, the handling of the milled enamel, and the composition of a good cast-iron white cover coat. Precautions to be taken in using sodium silicate in the mill additions for both coats are pointed out. For Part XXII see *Ceram. Abs.*, **12** [1], 7 (1933). E.J.V.

Methods for determining the resistance of enamels to acid attack. H. EISENLOHR AND HEINZ DIEHL. *Keram. Rund.*, **40** [6], 67–70; [7], 87–88 (1932); for abstract see *Ceram. Abs.*, **11** [4], 251 (1932). H.I.

Methods for testing enameled objects. I. ANON. *Emailwaren-Ind.* [*Émail*], **9** [18], 18–19 (1932).—The method of Vielhaber for testing resistance to mechanical shock and two methods for testing resistance to thermal shock are discussed. W.W.B. **II.** *Ibid.*, **9** [22], 25–26 (1932).—The method of Kinzie (*Ceram. Abs.*, **11** [3], 159 (1932)), simplified by Vielhaber, for testing the strength of the enamel is described. **III.** *Ibid.*, **9** [26], 31–32 (1932).—The different meanings of terms qualifying enamel, such as "resistant to acids," "acid-proof," and "acid resisting" are discussed. Enamels for cooking utensils should be tested with acids which are usually present in food. **IV.** *Ibid.*, **9** [35], 43–44 (1932).—Methods for testing enamels resistant to food acids are discussed. M.V.K.

Influence of manganese-silicon ratio upon inclusions in cast iron. F. J. COOK. *Foundry*, **60** [3], 44–46 (1932).—Recently a new type of inclusion in cast iron has been observed in cylinder castings of various types. The formation has the appearance of a spongy mass and is not evident until the castings are machined in the bore. C. shows that the formation of the inclusion depends upon the ratio of the manganese and silicon contents of the iron. The manganese content must be 0.5% below the silicon content in order to avoid the formation of these inclusions. It is believed that the inclusions are in the nature of manganese silicate. Illustrated with photomicrographs. F.G.H.

Equipment for the cleaning of metal. XXIII. R. W. MITCHELL. *Metal Cleaning & Finishing*, **4** [11], 589–92 (1932).—Continuing the discussion of electrocleaning in acid solution, M. describes the patented Bullard-Dunn electrocleaning process, and partly covers the Hanson-Munning bright dip acid cleaning process. Illustrated. For Part XXII see *Ceram. Abs.*, **12** [1], 9 (1933). E.J.V.

Cleaning iron and steel with alloying agents. R. C. GOOD. *Foundry*, **60** [2], 22–24 (1932).—G. explains the action of alloys on iron and steel with particular reference to those alloys acting as scavenging agents. The functions of silicon, zirconium, manganese, lime, and vanadium are discussed. F.G.H.

Grinding process for enamels. W. KERSTAN. *Emailwaren-Ind.*, **9** [45], 343–45 (1932).—The importance of fine grinding of enamels and the factors depending upon the fineness of grinding are discussed. W.W.B.

Portable unit for conditioning foundry sands. BEARDSLEY AND PIPER CO. *Foundry*, **60** [1], 60 (1932).—The operation of this device is described and illustrated. F.G.H.

Coal-dust bonded sand. B. HIRD. *Foundry Trade Jour.*, **47**, 181 (1932).—The

addition of 10% coal dust to molding sand reacts favorably on the casting. The coal becoming coked, tar oils are formed which coat the grains of sand in the outer portions of the mold and institute a bond utilizable in subsequent casts. H.H.S.

Production of a smooth and faultless enamel surface on products of the glass, apparatus, and iron industries. J. F. KESPER. *Diamant*, **54** [12], 178 (1932).—The most important and most recent processes used in the enamel industry are briefly discussed. E.J.V.

Protective nonmetallic coatings for chemical apparatus. I. A. MATAGRIN. *Rev. chim. ind.*, **41** [489], 253–60 (1932).—M. discusses in detail (1) protection of metals in chemical plants, (*a*) advantages and disadvantages of metallic materials, and (*b*) methods for protecting metals against corrosion; and (2) mineral protective coatings, (*a*) ceramic and glass coatings, and (*b*) vitrified chemical enamels, and enameled cast iron. Materials used by the French chemical industry are reviewed. M.V.K.

Enamel as a protection against corrosion. ALTMANNSBERGER. *Emailwaren-Ind.*, **9** [47], 360–61 (1932).—The protection of metals against corrosion by enameling is described. The suitability of various enamels for different purposes is discussed. W.W.B.

Economic operation of electric enameling furnace. A. M. YOUNG. *Elec. World*, **97** [24], 1168–70 (1931).—The study includes results obtained from the electric furnace with respect to (1) production, (2) power costs, and (3) improving operating methods. A high quality of enameling is economically possible through (1) reducing of "rejects" to a negligible per cent by (*a*) accurate control of furnace temperature, and (*b*) even distribution of heat throughout the furnace, (2) low labor cost, and (3) low maintenance cost. G.R.S.

Furnace control in enamel plants. OSCAR KERSTAN. *Glashütte*, **62** [41], 711–13; [42], 727–30 (1932).—K. discusses the importance of the rational operation of furnaces and apparatus used to obtain it, including the thermoelectric pyrometer, the radiation pyrometer, and measuring methods. M.V.K.

Proposed systematic classification of defects in the foundry. C. GIERDZIEJEWSKY. *Foundry Trade Jour.*, **47**, 127–28 (1932).—At the Milan International Congress, G. proposed an important system which is summarized in the following tables: I. Defects in size, 21 causes; II. Surface defects, 10 causes; III. Defects caused by sand, 16 causes; IV. Errors in pouring, 19 causes; V. Blowholes, 13 causes; VI. Draws, 9 causes; VII. Cracks and fissures, 16 causes; VIII. Defects caused by slags, 13 causes; IX. Liquation (melting), 7 causes; X. Defects of metal, 13 causes; XI. Entire classification in synoptic columns. H.H.S.

Basic cost of the enamel batch. L. VIELHABER. *Emailwaren-Ind.*, **9** [43], 329–32; [47], 361–62 (1932).—The determination of the basic cost of the enamel batch is discussed. In addition to the cost of the raw materials, the cost of mixing, melting, grinding, and other necessary processes is taken into consideration. W.W.B.

Some shop troubles in the enamel plant. GEORGE MONK. *Clay Prod. News*, **5** [11], 6 (1932).—M. discusses orange peel and its causes, black edging and problems it involves, scaling from sharp edges, copperheads, and the burning off of edges. W.W.M.

Development of porcelain enamel for the building industry. JOSEPH W. HOEHL. *Amer. Enameler*, **5** [6], 16–20 (1932).—H. outlines the development of "Glasiron" products or enameled tile for building exteriors. See also *Ceram. Abs.*, **11** [11], 554 (1932). W.W.M.

Steel interests look to enamel to solve low-cost house problem. ANON. *Ceram. Ind.*, **19** [6], 276 (1932).—New dwellings designed to sell for $3000 to $7000 are mentioned. Color properties and permanency are claimed to be selling points for these all-steel homes. W.W.M.

New foundry for Canadian National Railway. ANON. *Foundry*, **60** [1], 32–35 (1932).—The plant layout and equipment are described. Raw materials used, including limestone, clay, and molding sand, and the various operations involved are discussed. Illustrated. F.G.H.

Contract or piece work in enamel plants. II. R. BECKER. *Emailletech. Monats-Blätter*, **8** [11], 84–85 (1932).—B. discusses the methods of paying the individual workmen by the piece rate, as in the stamping room, by groups where helpers are needed in proper carrying out of the various stages of a process, or by a strictly weight basis, as in the annealing or pickling of the pieces. For Part I see *Ceram. Abs.*, **12** [1], 9 (1933). E.J.V.

The 4th International Foundry Congress. ANON. *Foundry Trade Jour.*, **47**, 165 (1932).—The Congress was held in Paris, Sept., 1932. H.H.S.

Types of enamels (early history). ANON. *Better Enameling*, **3** [11], 10 (1932).—Types of enamels are classed according to their construction. Under each heading the type is described, the method of manufacture given, and famous examples of the particular type of enamel under discussion are mentioned. References are included in the article. See also *Ceram. Abs.*, **12** [1], 10 (1933). W.W.M.

PATENTS

Method of making bathtubs. J. C. CROMWELL (Steel Sanitary Co.). U. S. 1,888,374, Nov. 22, 1932.

Furnace. L. W. MANION (Ferro Enamel Corp.). U. S. 1,889,928, Dec. 6, 1932. C. A. DUTTON (Ferro Enamel Corp.). U. S. 1,889,955, Dec. 6, 1932.

Continuous enamelware manufacture. H. T. BEBB (Canton Stamping & Enameling Co.). U. S. 1,890,897, Dec. 13, 1932.

Process for purifying an opacifying agent for enamels, glazes, and glasses. A. H. STEVENS (American Smelting & Refining Co.). Brit. 382,524, Nov. 2, 1932.

Glass

Constitution of glass. I. Explanation of glass anomalies on basis of dissociation and solvation phenomena. WOLDEMAR WEYL. *Glastech. Ber.*, **10** [10], 541–56 (1932).—An attempt is made to explain the so-called anomalies of the glassy state on the basis of the theory of ionization and solvation by treating them as chemical solutions. The following anomalies are thus explained: (1) energy content and specific heat, (2) stability of the glassy state, (3) volume-isobars and volume-isotherms, and (4) viscosity of glass. A bibliography on the subject is included. See also *Ceram. Abs.*, **11** [12], 609 (1932). W.W.B.

Theory and practice of the art of glassmaking. I. Formation of glass. EBERHARDT ZSCHIMMER. *Sprechsaal*, **65** [34], 622–24 (1932).—Glass is defined from both chemical and physical viewpoints. The newer theory of silicates and its consequences are presented. Coloring, opacifying, and fining agents are discussed. The glassforming elements that may be employed are listed and the significance of their position in the periodic table is pointed out. The limitation of the number of elements that may be employed in glass manufacture due to their cost is also indicated. *Ibid.*, **65** [35], 640–42 (1932).—The chief industrial glasses are classified according to the following three-component systems from which they are derived: (1) the soda-lime group, SiO_2, CaO, Na_2O, (2) the lead-crystal group, SiO_2, K_2O, PbO, and (3) the resistance group, SiO_2, B_2O_3, Na_2O. The manner in which other glasses are derived from these systems is described. The limits of glass formation within any system and the important glass constants are discussed. Suggestions as to how four- and five-component systems should be attacked are given. **II. Pot process.** *Ibid.*, **65** [38], 690–94 (1932).—The glass-pot process and its problems are discussed under the following headings: (1) variation of working temperature with soda content, (2) melting technique, (3) convection currents in molten glass, (4) revolving rotary kilns, (5) chemistry of glassmaking, (6) fining, (7) decolorizing, and (8) molecular structure of glass. W.W.B.

Glass industry technology: basic data on manipulation methods. W. E. S. TURNER. *Chem. Trade Jour.*, **91** [2372], 433 (1932); *Pottery Gaz.*, **57** [666], 1500–1501 (1932).—Four physical factors govern the manipulation of glass, (1) viscosity, (2) rate of change of viscosity with temperature, (3) tendency to devitrification, and (4) rate of loss of heat by radiation and conduction. The viscosity values obtained for glasses similar in composition to ordinary bottles are quoted (along with others for glasses richer in alumina) between 800 and 1300°. The alumina-containing glasses could be worked as well as the ordinary lime glasses, provided that the glass is discharged from the furnace at a suitable viscosity. A higher temperature is necessary all through the working range and better technique is called for, but the glasses are not unworkable. Data for bottles made on O'Neill and Owens machines are given. M.V.K.

Reactions between carbonic acid and silicates at high pressure. WOLDEMAR WEYL. *Glastech. Ber.*, **9** [12], 641–60 (1931).—The purpose of these researches was to investigate experimentally the reactions taking place between carbonic acid and silicate melts. The reciprocal action between this gas and the melts plays a considerable rôle in geology. In earlier investigations, especially by Wittorf and Niggli, equilibriums between carbonates and silicates are discussed. These equilibriums depend on the partial pressure of carbonic acid and the temperature. All these investigations, however, were made on basic systems and a low partial pressure of carbonic acid. Since the question

of gas equilibrium is important in glass refining, an experiment was made to increase the partial pressure of carbonic acid in order to reach equilibriums which could be analytically controlled. The apparatus and devices used are described in detail. The reaction between carbonic acid and sodium silicates produces equilibriums which are shifted to the carbonate side with increased pressure and lowered temperature. The pressure function and the temperature function were determined. The shifting of the increase in carbonic acid with the increase in acidity of the system, sodium metasilicate–silica, was also investigated. The investigation of corresponding potassium silicates showed that the equilibriums shifted to the carbonic side much more. Interchanges of potassium carbonates were observed which corresponded to the proportion, $K_2O:SiO_2::1:3$. The pseudo-binary system, sodium metasilicate–calcium metasilicate, was investigated under a carbonic-acid pressure of 750 atmospheres to determine the behavior of alkali-lime silicates. An approximately additive behavior of the components seems to be present here; extreme values for the combining of the eutectic could not be detected as well as in the system, sodium metasilicate–silica. Pure calcium metasilicate did not absorb marked amounts of carbonic acid during its α and β conversion. An intermediate place between alkalis and alkaline earth is occupied by lithium whose metasilicate may absorb marked quantities of carbonic acid. This peculiarity of lithium is discussed and the shape of the separation curve of cristobalite in the system, LiO_2–SiO_2, is pointed out. The synthesis of glasses which contained up to 8% carbonic acid (almost 20% sodium carbonate) necessitated the investigation of the reactions in the solid state. In most researches of these heterogeneous reactions, the temperature of the beginning of the reaction is dispensed with. As the reaction of the moving molecules proceeds rapidly, the time and temperature functions of these conversions are governed by the laws of diffusion. The intrinsic kinetics of reaction can be studied only on "molecular mixtures." The attempt to represent carbonate-silicate glasses as "molecular batches" showed that in these glasses the molecular arrangement is probably governed by static laws. The escape of gases from a carbonate-silicate glass with increasing temperature was tensiometrically measured. The temperature gradient of the escape of gases corresponds entirely to a diffusion process in its order of magnitude. The results obtained experimentally are explained and discussed. The refining of glasses is discussed as an example for the technical application of gas equilibriums with silicate melts; the important works dealing with this question are enumerated and it is shown how far the empirical data correspond with those of present researches. The similarity of sulfate-silicate equilibriums with carbonate equilibriums is pointed out. The few researches dealing with the reciprocal action of other gases, especially of oxygen, and the glass melt are also treated. M.V.K.

Review of recent progress in the study of thermal treatment of glass. J. T. LITTLETON. *Jour. Soc. Glass Tech.*, **15** [60], 262–306 (1931).—The importance of proper preparation of test samples of glass is stressed. Recent researches on this topic are reviewed. Viscosity data are discussed and an outline is given of the methods used in measuring viscosity. The effect of composition on viscosity and rate of setting are discussed. Six points, *viz.*, strain, annealing, warping, softening points, working temperature, and melting temperature, are sufficient to define the viscosity region which is of practical interest. Work on devitrification of glass can be subdivided into (1) study of the complete field of compositions, (2) speed of crystal growth under controlled conditions, (3) study of the devitrification property of glasses as shown by a standardized form of heat treatment, and (4) identification of stones in glass. Thermal-expansion coefficients can not be computed on an additive basis, but the effect of a particular constituent depends on the parent glass. Two types of thermal-volume change are (*a*) continuous dilatation with temperature, and (*b*) a permanent volume change when the heating and time cycle have exceeded certain limits. The effect of composition on expansion is treated. G.R.S.

Technology of glass in the light of scientific research. HANS JEBSEN-MARWEDEL. *Naturwissenschaften*, **19** [52], 1033 (1931).—The application of phase equilibria in oxide systems of glass components, effect of rate of cooling on glass, mechanism of the reaction of oxides, viscosity, crystallization, devitrification, gas evolution on reaction, corrosion of furnace linings, and other scientific principles as applied in glass technology are discussed. L.T.B.

Microchemical analysis of glasses. IV. Detection of fluorine in glass. W. GEILMANN. *Glastech. Ber.*, **9** [5], 274–79 (1931); abstracted in *Chem. Zentr.*, **ii**, 485 (1931).—Fluorine is converted into $BaSiF_6$ in the absence of SO_3; 0.5 to 1×10^{-6} g. of fluorine can be detected, or 1 to 3×10^{-6} g. as Na_2SiF_6, in which case the SO_3 does not interfere. Solutions of Zr salts form with Na alizarin sulfonate a reddish violet lake stable

toward HCl. This is decomposed by fluorine compounds yielding free alizarin, the color of which changes to yellow. P_2O_5, SO_3, and $H_2C_2O_4$ interfere. SiF_6'' can also be determined (10^{-4} g.) by means of the blue coloration produced in a molybdate solution containing benzidine and NaOAc. P, As, and Ca compounds interfere. A test involving the formation of SiF_4 is described. Glasses which release their fluorine only to fused alkali are first fused with NaOH. Alternatively, the glass may be fused with B_2O_3 and the BF_3 detected by the coloration produced on Zr paper. See also *Ceram. Abs.*, **10** [7], 489 (1931). M.V.K.

Influence of the manufacture and working of glass on its brittleness. A. RUSS. *Glastech. Ber.*, **9** [9], 481–501; [10], 529–43 (1931).—R. discusses (1) strength of glass and its impact strength; (2) measuring methods; (3) influence of thermal treatment on impact strength and literature on the subject; (4) influence of the melt on impact strength, (*a*) of the residuals of the batch, (*b*) of seeds in glass, (*c*) of streaks in lowering impact strength, (*d*) of crystallization; (5) influence of working, (*a*) of homogeneous stresses, (*b*) of thermal streaks; (6) influence of homogeneous stresses on impact strength and thermal resistance, (*a*) relationship between impact strength and thermal resistance, (*b*) influence of stresses on thermal resistance of massive and hollow bodies. The relationship between thermal history at high temperatures and impact strength was investigated on a series of glasses which were subjected to different thermal treatments. The action of the treatment on the impact strength is varied. Some glasses become worse, some remain unchanged, and some become stronger. The theory of thermal history need not be applied but changes in the strength of glasses can be explained much more simply. They are due to inhomogeneities in the glass and especially to the number and formation of streaks. "Blowing" has a great influence on the homogeneity and therefore on the strength. The influence of the melting process, *i.e.*, the duration, temperature, and refining, on impact strength of the glass can also be explained by the inhomogeneity of the glass. Undecomposed particles of the batch, streaks, seeds in glass, and sometimes devitrification affect the mechanical strength. The regularities of the change of homogeneity and with it, the impact strength, when changing the content of the mass, must be emphasized. The so-called thermal streaks appearing during the casting of glass lower the mechanical strength of the glass. The origin, means of avoiding, and influence of thermal streaks on the mechanical strength are discussed in detail. The relationship between impact strength and thermal resistance is treated. There is a certain parallel between impact strength and thermal resistance when a change in impact strength is conditioned by a general inhomogeneity. Impact strength and thermal resistance do not run parallel in a glass in which the stresses are distributed uniformly. The problems of normal, regularly distributed stresses and of hardening, with regard to its influence on impact strength and thermal resistance, are discussed also. M.V.K.

Interpolation formula for the refractive indices of glass. MRS. E. GIFFORD. *Sprechsaal*, **65** [34], 626 (1932); for abstract see *Ceram. Abs.*, **11** [12], 609 (1932). M.V.K.

Notes on refractive indices. MRS. E. GIFFORD. *Trans. Opt. Soc.* [London], **33** [2], 66 (1931–32); *Sprechsaal*, **65** [34], 624–25 (1932).—The refractive and dispersion properties of some liquids and crystals are compared with those of glasses of similar mean dispersion. It would appear from the comparisons that the dispersions of the liquids in the red end are smaller than the glasses and in the violet end are larger than the glasses, while with crystals the reverse is the case. Liquids have smaller refractive indices than glasses of similar dispersion. The reverse is the case with crystals. See preceding abstract. J.T.L.

New theoretical works dealing with the diffusion of light in turbid media. F. VON GÖLER. *Glastech. Ber.*, **9** [12], 660–65 (1931).—Ryde and Cooper (see *Ceram. Abs.*, **10** [8], 554 (1931)) developed a theory of diffusion of light in opaque media with special regard to reflection (total reflection) on the surface, carrying on the previous work of Gurevič and Dreosti (*ibid.*, **10** [11], 761 (1931)). The indices suggested for indicating an opaque material are discussed. The constants can be determined in a piece of glass; q can be determined from the direct permeability, and μ and NB, from the measurements of the diffused permeability and the reflection in diffused light or, when the direct permeability is less than 0.1, from measurements in parallel light. The direct and diffused permeability, the diffused reflection in parallel light, and the permeability and reflection in diffused light can be calculated from the three indices also. A series of simplifications are used in this theory, the most important being that of the uniformity of the different layers of the glass and equality of structure with different thicknesses of the glass. The formulas are applicable for monochromatic light. M.V.K.

Absorptive capacity of different hollow and sheet glasses to yellow etching. LUDWIG

SPRINGER. *Glastech. Ber.*, **9** [6], 334–40 (1931).—A study was made of the yellow etching of various glasses by firing in Ag compounds (usually AgCl and ocher, 1:5) which had been applied to the surface of the glass by spraying or painting. The degree of coloration by absorption of Ag is influenced by the chief constituents of the glass, *e.g.*, soda glasses show greater absorption than potash, Ba glasses more than lime, while Pb glasses exhibit but slight effect. Secondary glass constituents cause a greater effect, especially As and Sb_2O_3 and even small amounts of FeO, C, or S compounds. Neither Mn nor alumina affects the coloration. Saltpeter counteracts the action of As. Red coloration by Cu is not affected either by As and FeO or by Sb_2O_3. A color table showing the various yellow color tones obtained is given. See also *Ceram. Abs.*, **11** [8], 446 (1932). M.V.K.

New coloring agents for glass. ANON. *Glastech. Ber.*, **10** [3], 183 (1932); for abstract see *Ceram. Abs.*, **11** [11], 561 (1932). M.V.K.

Notes on the manufacture of special glasses. VIII. Colorless glasses. ANON. *Glass*, **9** [10], 426–34 (1932).—The prevention and elimination of "seed" are discussed under the headings, (1) use of cullet, its effects, the quantity used, its condition, and the influence of fluxes on cullet, (2) changing the batch, and (3) the furnace, melting area, furnace condition, and secondary seed or "after-boil." **IX.** *Ibid.*, **9** [11], 469–73 (1932).—The melting process with reference to the furnace is treated. The melting area, condition of furnace, secondary seed or "after-boil," distribution of temperature, flame condition, and the formation of seed due to iron are discussed. For Parts VI and VII see *Ceram. Abs.*, **11** [12], 611 (1932). G.R.S.

Decoloration of glass. ANON. *Ind. chimique*, **19** [218], 226 (1932).—To obtain decoloration of glass, the iron must be maintained at its maximum state of oxidation. The elevation of the temperature promotes the formation of ferrous oxide. In sulfate glasses melted without additions of charcoal, oxygen is liberated which checks the dissociation of ferric oxide. The action is promoted by adding barium sulfate. Arsenic added to the glass is transformed into arsenic acid at high temperatures which checks the dissociation of ferric oxide. Calcium fluoride decolorizes glass by causing the formation of a slightly colored complex. Nickel is especially adapted for decoloration. M.V.K.

Researches on cerium decoloration. I. JOHANNES LÖFFLER. *Glastech. Ber.*, **9** [9], 501–507 (1931).—L. discusses the following subjects: (1) cerium as an admixture absorbing ultra-violet rays and as a refining addition to glass; (2) discolorations of cerium glasses; (3) determination of the lowest and highest limit of the cerium content in discolored glasses; (4) influence of other admixtures on the discoloration of glasses containing cerium and free from it; (5) principles of decoloration with cerium; (6) decoloration by means of cerium in small and large quantities of melts; (7) refining of cerium glass melts with saltpeter, common salt, and sodium sulfate; (8) results obtained with a simultaneous decoloration with nickel and selenium and in melts containing some cullet. See also *Ceram. Abs.*, **11** [10], 521 (1932). M.V.K.

Progress in improvement of glass by sandblast. H. CRAEMER. *Diamant*, **54** [11], 165 (1932).—The production of etched glass by use of the sandblast instead of by acid etching is briefly discussed. E.J.V.

Sandblasting and its use for improving the quality of glass. U. LOHSE. *Glastech. Ber.*, **9** [4], 197–204 (1931).—L. discusses different types of sandblast apparatus used for grinding, ornamenting, and decorating glassware, their service, and efficiency. See also *Ceram. Abs.*, **11** [10], 523 (1932). M.V.K.

Processes taking place during purification of glasses with arsenic. F. SALAQUARDA. *Sprechsaal*, **65** [27], 492–94; [28], 514–15 (1932).—In the present work, S. investigated the behavior of arsenic in glass melts with regard to the known fact that arsenite converts into arseniate with the separation of metallic arsenic during heating, and with regard to the researches of G. G. Reissaus (*Z. angew. Chem.*, **44** [50], 959–62 (1931)) on the reaction $5As_2O_3 \longrightarrow 3As_2O_5 + 4As$ as a pyrochemical and photochemical process. R. also detected this course of reaction during heating for mixtures of arsenic and metallic bases. Three water-glasses of the composition $3SiO_2 \cdot 2Na_2O$ with varied arsenic content and melted in an oxidized, neutral, and reduced atmosphere were investigated. The researches were made on the behavior of the glasses during melting and purifying, the determination of the stages of oxidation of arsenic, and the determination of the loss in arsenic. The following conclusions were reached: (1) A separation of metallic arsenic appears in glasses melted in a reducing and neutral atmosphere but not in glasses melted in an oxidizing atmosphere. (2) Glasses melted in an oxidizing atmosphere contained 90.7 to 94.5%, those melted in a neutral atmosphere, 73.0 to 78.5%, and those melted in a reducing atmosphere, 61.0 to 66.3% of total arsenic as

arsenic (5) oxide (analytically determined); independent of the melting method, glasses with an average concentration of arsenic showed an unexplained minimum of arsenic (5) oxide. (3) The losses due to melting, for introduced arsenic, amounted to 13.0 to 18.8% in glasses melted in oxidized atmosphere, 27.0 to 34.8% in neutral, and 47 to 55.6% melted in reduced atmosphere. (4) Glasses melted in an oxidizing atmosphere purify normally. The time (the same for all glasses) used for purifying glasses melted in a neutral atmosphere and those melted in a reducing atmosphere was insufficient for a complete purification. It can be assumed, therefore, that arsenic reacts also in glasses according to the equation, (*a*) $5As_2O_3 \longrightarrow 3As_2O_5 + 4As$ (arsenite $\longrightarrow$ arseniate + met. arsenic), and that another reaction takes place in the presence of oxygen, (*b*) $4As + 6O \longrightarrow 2As_2O_3$. It is probable that the decoloration of glasses containing arsenic depends on a separation of elementary arsenic which is liberated by a course of reaction similar to the equation (*a*). M.V.K.

Nature of sand for glassmelting. K. KILLER. *Glashütte*, **62** [41], 711 (1932).—K. discusses the composition of quartz sand used for the production of crystal glass. The structure of the sand grain, its size, and age are of considerable importance. M.V.K.

Alabaster glass. ANON. *Glashütte*, **62** [38], 662–63 (1932).—Attempts to replace alabaster potash used in the manufacture of alabaster glass by other kinds of potash, *e.g.*, hydrated or calcined potash, are described. The glass obtained was of good quality. M.V.K.

Alumina in glass. J. H. DAVIDSON. *Glass*, **8** [8], 334–36 (1931).—Alumina in glass (1) increases durability, (2) helps to prevent devitrification, (3) increases mechanical, tensile, and crushing strength, (4) lowers the annealing temperature, (5) reduces the coefficient of thermal expansion, (6) extends the working range, (7) reduces the corrosive attack of the glass on the refractory, (8) increases the brilliance and luster of the glass, and (9) affects the viscosity. The most efficient and economical means of adding alumina is by the use of feldspar. The use of borax simultaneously with feldspar is discussed. G.R.S.

Fluxing of silica: a note on silica equilibrium diagrams. J. F. HYSLOP. *Jour. Soc. Glass Tech.*, **16** [63], 327–30 (1932).—Four graphs are given with the discussion. G.R.S.

Experiments on selenium glasses. L. SPRINGER. *Sprechsaal*, **65** [43], 790–92 (1932).—A number of experiments on selenium glasses were carried out to determine (1) the maximum amount of selenium that will be taken up by the glass and still produce an increase in color, (2) the differences resulting from the use of elementary selenium or sodium selenite, and (3) the influences of arsenic and potassium nitrate on both preparations. It was found that there was a definite limit as to the amount of selenium that will produce an increase in color in any particular glass. Elementary selenium gives a much deeper color than an equal amount of selenium added as sodium selenite. Arsenic increases the color with sodium selenite and decreases it with elementary selenium. Potassium nitrate has a slight intensifying effect on elementary sodium selenite and a marked diminishing effect on elementary selenium. If cadmium sulfide is also added the sodium selenite is unaffected, but the elementary selenium color becomes yellowish. W.W.B.

Method of analysis of soda-lime glasses, especially from the viewpoint of rapid determination of the alkalis. A. NOEL. *Rev. belge ind. verrières, céram., émail.*, **3** [1], 2–3; [2], 26–29 (1932).—N. discusses general difficulties of alkali determination. The following methods are cited: (1) Appert-Henrivaux, alkalis are determined as chlorides; (2) H_2SO_4-HF, alkalis are determined as sulfates; (3) J. Lawrence Smith, alkalis are determined as chlorides; (4) Barber and Kolthoff; (5) Glaze, alkalis are determined as uranyl zinc sodium acetate (*Ceram. Abs.*, **10** [7], 485 (1931)). N. proposes a method by which alkalis are determined as sulfates with sufficient accuracy and greater speed. Four analyses are tabulated by the old method and four by the new, showing the workability of the latter method. P.E.C.

Sodium-calcium double carbonates as weathering products of soda-lime glasses. A. DIETZEL. *Sprechsaal*, **65** [46], 825–26 (1932).—Microscopic and microanalytical studies of the weathering products of soda-lime glasses show that the following carbonates are formed: under 40°C, Gaylussite, $Na_2Ca(CO_3)_2 \cdot 5H_2O$; between 40 and 100°C, Pirssonite, $Na_2Ca(CO_3)_2 \cdot 2H_2O$; and above 100°C, anhydrous $Na_2Ca(CO_3)_2$. W.W.B.

Formation of glass when using sodium silicate. I. I. KITAIGORODSKII AND N. SOLOMIN. *Glastech. Ber.*, **9** [6], 349–54 (1931); see also *Ceram. Abs.*, **11** [2], 86 (1932). M.V.K.

Calcium fluoride as a refiner of glass and its influence on the acidity of phial glasses. F. DE CARLI. *Giorn. chim. ind. applicata*, **14** [7], 364 (1932).—The difficulty of using

fluorite to refine glasses for phials is that it reacts with the silica on heating to form fluosilicic acid. Ammonium carbonate should be used instead. M.V.K.

Separation of glass during cooling. G. Y. Zhukovskii. *Keram. i Steklo*, **8** [5–6], 12–14 (1932).—J. discusses the researches of Shvetzov (*Ceram. Abs.*, **11** [5], 300 (1932)) on the separation of glass into layers on cooling and concludes that this separation does not occur while the glass is molten in the tank. M.V.K.

Experimental studies on the form and growth of cracks in glass plates. M. Hirata. *Glastech. Ber.*, **10** [4], 285 (1932); for abstract see *Ceram. Abs.*, **11** [10], 520 (1932). M.V.K.

Avoiding defects in glassware by correct batch mixing. F. Gelstharp. *Ceram. Ind.*, **19** [5], 231–34 (1932).—Raw materials for plate- or window-glass batches should be thoroughly mixed and subsequent segregation prevented as far as possible. The effects of local excessive proportions of various ingredients in the batch are described. Specifications for the best forms of soda ash, limestone, dolomite, and saltcake for use in the batch are given. Storage of materials, batch mixing, and machines for filling the pots are discussed at length. Proper mixing avoids stones in the glass, reaming, stringing, etc. W.W.M.

Defects in glass manufacture. O. Herfurth. *Glastech. Ber.*, **9** [6], 361 (1931); see also *Ceram. Abs.*, **11** [9], 485 (1932). M.V.K.

Formations appearing on the glass surface in the cooling furnace. M. F. Shur and N. N. Vesselkova. *Glashütte*, **61** [11], 186–87 (1931); abstracted in *Glastech. Ber.*, **9** [8], 471 (1931); for abstract see *Ceram. Abs.*, **10** [5], 336 (1931). M.V.K.

Manufacture of glass with an enamel coat. S. Girovani. *Ind. Silicati*, No. 6, pp. 7–8 (1930); abstracted in *Glastech. Ber.*, **9** [5], 315 (1931).—After a short historical review, a method is described for decorating window glass with a colored enameled coat. A paste prepared from a mixture of kaolin, glassforming silicates, and metallic oxides is used which, after being fired, forms a colored (mostly black) fused mass of a high consistency. The materials are stirred with a tragacanth solution. The colors are composed of flux masses (minium, quartz, and boric acid) with corresponding coloring pigments. Three typical batches are (1) 75 parts minium and 25 quartz; (2) 70 parts minium, 20 boric acid, and 10 borax; (3) 30 parts sand, 12 potash, 8 soda, and 30 minium. With this for a foundation, the colors are prepared as follows: cobalt oxide 0.7 (blue), copper oxide 4.3 (blue) or 3.4 (green), iron oxide 6.1 (green), pyrolusite 2.5 (green) or 7.0 (violet), and the flux mass. The coloring constituents are zinc oxide (white), lead nitrate (yellow), uranium oxide (yellow), iron oxide + tin oxide + antimony oxide (yellow-brown), barium chromate (dark yellow), cuprous oxide (red), "Cassius" purple (brilliant red), cobalt oxide (blue), copper oxide (green), pyrolusite + iron sulfate (brown), nickel oxide (black), and iridium oxide (black). The colored pastes are applied and then fired. Muffle furnaces of different types and fired with wood, coal, or gas or heated electrically are used. The maximum temperatures required lie below 750°. Glasses colored in this way are joined with strips of lead. M.V.K.

Chemical testing of the surface of plate glass. Hans Jebsen-Marwedel and Alfred Becker. *Glastech. Ber.*, **10** [10], 556–59 (1932).—The control of the corrosion-resistant qualities of plate-glass surfaces is discussed, and the modified Keppeler trough method for the lixiviation of these surfaces is given in detail. W.W.B.

Statistical methods for routine testing of bottles. F. C. Flint and A. K. Lyle. *Jour. Soc. Glass Tech.*, **16** [63], 360–74 (1932).—The paper describes the use of statistical methods in comparing results from various tests of glass bottles. The several necessary and important statistical relationships are defined, their meaning is explained, and their relative usefulness pointed out. Illustrations are provided from data on impact, internal-pressure, and thermal-shock tests. The results indicate that the size of the sample which should be taken for test varies within fairly large limits depending on the permissible accuracy of the variability of the product, and on the accuracy of the testing method used. G.R.S.

Progress in the manufacture of Pyrex brand glass. Anon. *Génie civil*, March, 1931; *Ind. chimique*, **18** [215], 889 (1931).—The principal characteristics of Pyrex brand glass are given. M.V.K.

Modern optical glass as exemplified by the list of the Parsons Optical Glass Company. T. Smith. *Trans. Opt. Soc.* [London], **32** [3], 85–100 (1930–31); *Kodak Research Lab., Abs. Bull.*, **28** [6], 300 (1932).—The relations between the dispersions for the sections of the spectrum for the glass types catalogued by the Parsons Optical Glass Co. (September, 1926) are discussed. The data would indicate that there are no glasses suitable for making apochromatic telescope objectives of large relative aperture. A new graphical method of interpolating refractive indices for glass is obtained. J.T.L.

Glass for scientific appliances. CHALLIAT. *Rev. ind.*, June, 1931; *Ind. chimique*, **19** [221], 430 (1932).—C. describes the manufacture of crucibles and glasspots. The crucibles are made from pure clay coming chiefly from Provins. They must not be affected by the constituents of the glass so that the nature of the latter will not be modified. The crucibles are broken to obtain the glass, which is annealed. The glasses must be annealed carefully to prevent them from becoming birefringent or devitrified. Glasses without defects are used in optics for high precision. M.V.K.

Testing eye-protecting spectacles. GOTTFRIED ROSE. *Glastech. Ber.*, **9** [7], 389–90 (1931).—An outline of tests according to the "falling ball" method is given. M.V.K.

Manufacture of glass at the Mogutovski glassworks. M. KHOKHRYAKOV. *Keram. i Steklo*, **8** [7], 9–11 (1932).—K. describes the manufacture and properties of cover glass used with microscopes. The batch for such a glass should have an alkali content up to 19%. The glass is blown into elongated balls which are cut into strips, straightened in a special furnace, cut into squares, and calibrated according to the thickness of the glass. The technical requirements for a cover glass specify that the glass must be colorless and not contain any seeds, streaks, stones, or other inclusions. A local sand with an 0.11% iron-oxide content is used with good results, although the amount of selenium as decolorizer had to be increased. M.V.K.

Influence of the form of edges in illuminating lenses and their thermal endurance. J. FLÜGGE. *Glastech. Ber.*, **9** [8], 463–65 (1931).—F. discusses (1) hardening, (2) special glasses, (3) influence of cooling, and (4) polishing and working the edges of lenses in the manufacture of heat-resisting lenses. See also *Ceram. Abs.*, **11** [3], 169 (1932). M.V.K.

Physicochemical principles of glass reflection. M. VOLMER. *Glastech. Ber.*, **9** [3], 133–39 (1931).—The physical properties of mirrors and methods used for their production are discussed. A bibliography is given. M.V.K.

Source of danger of explosion in chemical silvering of glass and precaution for its prevention. EDUARD LOHMANN. *Diamant*, **54** [14], 212–13 (1932).—The chemistry of the process of chemically silvering glass is discussed in detail. See also *Ceram. Abs.*, **11** [11], 561 (1932). E.J.V.

Diffusion of gases through fused quartz. LIU SHENG T'SAI AND T. R. HOGNESS. *Jour. Phys. Chem.*, **36** [10], 2595–2600 (1932).—The permeability of quartz glass for various gases is greater for the atoms or molecules of smaller cross-section. G.R.S.

Glasses for use with invisible light. S. ENGLISH. *Glass*, **8** [12], 509 (1931).—In glass transmitting ultra-violet light it is necessary to (1) keep iron oxide below 0.02%, (2) convert this iron to the ferrous condition, and (3) remove dissolved oxygen. Wood's glass, a strongly colored NiO glass on a K_2O base, transmits invisible rays but absorbs the visible rays. Three types of glasses are described for use in (1) transmitting both visible and heat rays, (2) absorbing heat and transmitting visible rays, and (3) transmitting heat but absorbing the visible rays. See also *Ceram. Abs.*, **11** [11], 558 (1932). G.R.S.

Light transmission and tint of building and illuminating glass. H. CRAEMER. *Diamant*, **54** [15], 225–26 (1932).—The requirements of light transmission in glass for skylights, windows, wall covering, walls, and for illuminating, and the effect of different tints in the glass on its transmitting power are discussed. E.J.V.

Contribution to the standardization of safety-glass testing. FRITZ OHL. *Sprechsaal*, **65** [43], 773–75 (1932).—An effort is made to correlate the discoloration of safety glass, as produced by illuminating with a quartz mercury-vapor lamp for a definite length of time, with the shatterability. A weight of 750 g. is dropped on the glass from a height of 3 m. It is necessary to drop the weight the same distance from the edge of the glass each time in order to get concordant results. Illustrations of tests and graphs of results are given. See also *Ceram. Abs.*, **11** [12], 612 (1932). W.W.B.

Manufacture and properties of safety glass and its intermediate layer. E. DIETEL. *Sprechsaal*, **65** [34], 627 (1932); see also *Ceram. Abs.*, **11** [12], 612 (1932). M.V.K.

Shatterproof glass. M. NAPHTALI. *Chem. Met. Eng.*, **39** [11], 601 (1932).—A radical departure in the manufacture of shatterproof glass has taken place in Germany. Sekurit glass, as the new product is called, is made from highly polished sheets of plate glass treated by a special hardening process which obviates the necessity of an adhesive medium between the individual plates. The brittleness of the glass is greatly reduced, and its high elasticity and flexibility resemble that of spring steel. See also *Ceram. Abs.*, **11** [6], 357 (1932). G.R.S.

Another approach to "unbreakable" glass? J. M. HAMMER. *Amer. Glass Rev.*, **52** [2], 11–12; [5], 17 (1932).—"Bounceable" tumblers from Czechoslovakia may be

similar to "malleable" glass which Leighton sought and Kauffeld claimed more than 30 years ago. E.P.R.

Safety glass. ANON. *Diamant*, **54** [16], 242–43 (1932).—The principles involved in the production of safety, nonsplintering glass are enumerated, and some commercial applications of the product with results of tests thereon are described. Illustrated. E.J.V.

Safety glass. A. BRESSER. *Keram. Rund.*, **40** [10], 124–25 (1932).—A description of patents is given. See also *Ceram. Abs.*, **11** [5], 300 (1932). H.I.

Strength of glass tubes at high temperatures. H. v. WARTENBERG, B. GREINER, Z. TABACZNIK, D. JANASZEWSKI, AND A. KRAWUTSCHKE. *Z. tech. Physik*, **13** [10], 479–81 (1932).—A glass tube was connected to a bomb containing compressed air. The average tensile strength of the glasses investigated varied from 450 to 650 kg./sq. cm. The tubes were then heated by means of an electric furnace and internal pressure was applied as in the room-temperature experiments. It was found that the strength of the glasses remained about the same as at room temperature if the temperature was kept below the transformation point. At higher temperatures, however, they would not withstand as great a pressure. The tensile strength was determined for four common glasses, the radius of the tubes, thickness of wall, and temperature being varied. W.M.C.

Fusing glass parts together. H. FISCHER. *Glastech. Ber.*, **9** [4], 204–11 (1931).—The methods used in practice for melting glass parts together can be divided into two main groups in which (1) the melting occurs directly, and (2) an "intermediate glass" having a lower melting point is used between the parts of the glasses to be joined. These methods are similar to welding and soldering in metallurgy, and therefore these two terms might be used in glass technique. A further classification can be made according to the degree of softening of the glasses to be combined and with regard to their composition. Heretofore, glasses having common surfaces of contact could be melted together only with the help of an intermediate glass, but now it is possible to melt together glass parts having only tangents in the form of bundles of tubes or pipes. The "intermediate glass" changes the tangents into narrow surfaces of contact. The field of application of such glass tubes melted together is discussed. When soldering thin glass rods having different compositions and coefficients of expansion, curvatures appear which can be applied for the qualitative and, possibly, for the quantitative measurement of small differences in the expansion of glasses. M.V.K.

Tube glass. KITSUZO FUWA. *Jour. Jap. Ceram. Assn.*, **38** [448], 209–28 (1930).—Descriptions and discussions are given on the manufacture and uses of glass tubes, the method of manufacturing test tubes, etc., gas burners for glassworking, gas-flame test of glass, chemical tests of glass, etc. S.K.

Glass as industrial material for electrotechnique. F. LAUSTER. Reprint from Helios, No. 24, 31 pp. (1930); abstracted in *Glastech. Ber.*, **9** [6], 360–61 (1931).—L. discusses the mechanical and thermal properties of glasses with regard to their differences with metals. To decrease the fragility of glasses their tensile strength must be increased; this can be done only by special annealing of the glass (according to Schott) since changes in the composition of the glass are insufficient to increase the tensile strength. Directions are given for cooling glass alone and when combined with metal. Methods used for combining glass and metal according to patent literature are described. Glass used in electrotechnique for X-ray tubes, mercury switch tubes, vacuum switches, etc., is discussed. M.V.K.

Insulators of silica glass (quartz insulators). F. SKAUPY. *Elektrotech.-Z.*, **51**, 1745–68 (1930); abstracted in *Glastech. Ber.*, **9** [5], 315–16 (1931).—S. discusses various materials used for insulators and their defects, and describes the manufacture of silica glass. The physical and chemical properties of silica glass with special regard to its use for insulation and the special advantages which silica-glass insulators have for high tension and free transmission, for high temperatures, and for high frequency, especially for short waves, are treated. The manufacture of different kinds of silica-glass insulators is described. M.V.K.

Demands of glass for the electrical industries. FRIEDERICH SPÄTE. *Glastech. Ber.*, **10** [10], 521–40 (1932).—The general requirements for glass used for electrical purposes are (1) transparency to various kinds of radiations, (2) nonpermeability to gases, and (3) high-electrical insulating power. The following topics are discussed: (1) behavior of glass with respect to electricity, (2) dielectric constants, (3) dielectric losses, (4) melting of metals with glass, (5) action of mercury and various radiations on glass, and (6) nonelectrical demands made on glass. The use of glass for incandescent lamps, ultra-violet ray lamps, electrical discharge tubes (point-light tube, glow lamp, neon

tubes, etc.), rectifier, radio amplifier, and transmitter tubes, mercury-arc rectifier tubes, photoelectric cells, and glass insulators is described. Many illustrations and an extensive bibliography are included. See also *Ceram. Abs.*, **11** [2], 89 (1932). W.W.B.

Filter plates from porous glass. P. H. PRAUSNITZ. *Tech. Blätter*, No. 46, p. 956 (1930); *Glastech. Ber.*, **9** [4], 241 (1931).—Glass filters are manufactured from apparatus glass whose average diameter of pores varies between 1 and 500μ. They are used for (1) filtration, in the form of crucibles and suction filters, (2) for extraction, in the form of suitable apparatus, and (3) for dispersing gases in liquids, in the form of gas-washing bottles. Large filter plates of 200- to 600-mm. diameter with coarser or medium width of pores can be manufactured for technical purposes. M.V.K.

Annealing of commercial glassware. II. F. W. NOEL. *Glass Ind.*, **13** [12], 192–95 (1932).—After a discussion of inhomogeneous glass, effect of stress on the strength of the ware, and shock tests, N. summarizes as follows: (1) Annealing temperature and, to some extent, viscosity vary with glass composition. (2) Annealing temperature is based on rate of change of viscosity with temperature. (3) Rapid cooling can commence in a precisely controlled leer 50 to 60°C below the determined annealing temperatures for most commercial soda-lime glasses. (4) Rate of cooling can be progressively increased by shortening the time for bottles through the leer until a uniform layer of compression is established on the outer surface, provided the stress in other directions is negligible. (5) A uniform layer of compression on the outer surface renders the bottle better able to withstand processing and general handling. (6) Examination in the polariscope of a ring section cut from a bottle will reveal external compression. (7) Tests should be applied to ascertain that the colored bands seen when examining a section are not due to inhomogeneity. (8) Existence of tension on the outer surface of a bottle is very dangerous. (9) Routine tests reproducing as far as possible actual processing conditions should be applied to ascertain the extra strength gained by increasing the external compression. For Part I see *Ceram. Abs.*, **12** [1], 13 (1933). E.J.V.

Effect of age on the strength of commercial glassware. J. B. MURGATROYD. *Jour. Soc. Glass Tech.*, **16** [63], 350–59 (1932).—The thermal endurance, bursting pressure, and impact strength of several groups of glassware stored (*a*) in a warm, dry, atmosphere, and (*b*) in the open without cover, were determined at various ages from 0.2 to 28 days; one group was tested for thermal endurance at various times up to 4 months after manufacture. No indication of change in the strength of the articles was found exceeding the probable error of the tests at any age up to 4 months. G.R.S.

Soldering glass to metal. J. F. KESPER. *Diamant*, **54** [17], 256 (1932).—A brief description of the method followed in soldering glass to metal is given. E.J.V.

Molds for domestic glassware. H. W. HOWES. *Pottery Gaz.*, **57** [666], 1498–1500 (1932).—Any investigation into the subject of molds necessitates a study of such related factors as shape, mold temperature, thermal conductivity of mold material, the specific heat of mold material, wall thickness of the mold, temperature of the glass, weight of the glass article, speed of working, artificial cooling arrangements, etc. The requirements of an ideal material for hot mold construction and some necessary properties are listed. Other materials considered include special mold materials, paste or spun-ware molds, wooden molds, and molds for hand-blown ware. E.J.V.

Manipulation of felts for rational grinding and polishing in the glass industry. J. F. KESPER. *Glastech. Ber.*, **9** [12], 671–72 (1931).—The selection of felts, their preparation for coarse, medium, and fine grinding and for polishing, and the polishing of plate, optical, and crystal glasses are discussed. M.V.K.

Protection of tank blocks against rapid solution. H. HAUSNER. *Keram. Rund.*, **40** [23], 291–92; [24], 307–10 (1932); for abstract see *Ceram. Abs.*, **10** [6], 418 (1931). H.I.

Protective compound for glasshouse refractories. RELINUS CO. *Amer. Glass Rev.*, **52** [4], 15 (1932); for abstract see *Ceram. Abs.*, **11** [11], 575 (1932). E.P.R.

Protective layer between refractory and glass melt. D. S. BELYANKIN AND W. A. EGOROV. *Keram. Rund.*, **40** [21], 265–69 (1932).—The chemical compositions of the porcelain-like zone between refractory and glass in a glasspot and the porcelain-like layer on the surface of a refractory exposed to batch dusts were compared with the compositions of the refractory and the glass melt. The porcelain-like zone increased in alkalis but in the rest of the composition remained similar to the refractory. The intermediate zone contained mullite and glass in one case and mullite, corundum, and glass in the other. H.I.

Improvement in glassmelting furnaces. G. KÖRRN. *Keram. Rund.*, **40** [27], 345–48 (1932).—Methods of construction of different portions of the furnace such

as side walls, crown, etc., to permit rapid, convenient, and cheap repairs are described. H.I.

Mathematical and analytical considerations for oil-fired tank furnaces. I. HOROWITZ. *Glashütte*, **62** [43], 741–43 (1932).—The paper develops a mathematical method permitting the determination with sufficient accuracy of the conditions taking place during the operation of a tank furnace, and the deduction of generally applicable laws on the dependence of fuel consumption on the charging of tank furnaces. M.V.K.

Melting glass and silicates. G. A. ZOTOS. *Jour. Soc. Glass Tech.*, **16** [63], 284–92 (1932); for abstract see *Ceram. Abs.*, **11** [8], 449 (1932). G.R.S.

Heat-technical investigation of a glass tank. W. FRIEDMANN. *Glastech. Ber.*, **10** [11], 593–610 (1932).—The following new measuring instruments were tested: (1) gas-flow pyrometers for measuring the temperature of the gas mixture in various stages of combustion, (2) a surface pyrometer for measuring the temperature of the tank wall, (3) an instrument for measuring the thermal conductivity of the walls, and (4) an accurate pressure measuring and regulating device. The points at which measurements should be made, the distribution of temperatures in different parts of the furnace, and the nature of the flame are discussed. The effects of (1) the thermal conductivity of the brickwork, (2) the amount and distribution of gases in the furnace, (3) the distribution of heat losses through the walls, and (4) the thermal convection currents within the molten glass on the heat balance in the different parts of the furnace are described. W.W.B.

Bottle-blowing machines for blowing bottles of different shape and size. L. ROTHAAS. *Z. Ver. deut. Ing.*, **75** [52], 1548–53 (1931); *Glastech. Ber.*, **10** [8], 448–49 (1932).—New developments in bottle-blowing machines, especially those by which greater variety in size and form of bottles may be obtained, are described. Various machines are described and photographs and plans of these machines are included. L.T.B.

Strainviewer for large glassware. C. F. SMITH. *Glass*, **9** [11], 468 (1932).—The polarizing lantern is on one stand while the analyzing eyepiece is on another. The working aperture, 15 in. square, can be made much larger. The working space between the two stands is about 6 ft., and the height can be adjusted to suit the operator. Large pieces of sheet glass can be easily tested. Illustrated with diagrams and photos. G.R.S.

Mold materials and design. THOMAS WARDLEY. *Pottery Gaz.*, **57** [666], 1496–98 (1932).—W. deals at some length with such problems as the effect upon mold design of the peculiarities of the numerous types of glassforming machines, etc. He discusses available mold materials, alternatives for cast iron, heat-resisting alloys, electroplated molds, and the choice of iron for molds. E.J.V.

Glass as a wall and floor covering. ANON. *Diamant*, **54** [15], 227–28 (1932).—Properties requisite in a glass to be used as a wall or floor covering are enumerated. E.J.V.

Stained glass of John Rowell. AMBROSE HEAL. *Notes & Queries*, **163**, 38 (1932).—R., a glazier of High Wycombe, born 1694, developed a durable and beautiful red in stained glass, the method for which died with him. H.H.S.

Old English glasses. No. 36. Flutes. F. BUCKLEY. *Glass*, **9** [11], 482–84 (1932).—Tall glasses with narrow elongated bowls, which have been called "ale" and "champagne" glasses, would be described better by their old technical name of "flutes." The first mention of the flute for wine is 1650. One or two of these tall flutes in old Venetian glass have survived. Illustrations show flute, wine, and beer glasses in the baluster stem period for comparison. For No. 35 see *Ceram. Abs.*, **12** [1], 5 (1933). G.R.S.

Origin, history, and spreading of old Thuringian families of glassmakers. HERBERT KÜHNERT. *Glastech. Ber.*, **9** [6], 325–34 (1931).—A historical sketch is presented of the development of well-known families of glass manufacturers in Thuringia. See also *Ceram. Abs.*, **11** [11], 551 (1932). M.V.K.

Old opinions on the making of plate glass. ANON. *Rev. belge ind. verrières, céram., émail.*, **3** [1], 3–4 (1932).—A reminiscent article describes early attempts in making plate glass with rolls on the order of steel rolling, the purchase of the Bessemer invention by a French manufacturer, and the difficulties encountered. The reasons why casting and rolling succeeded where the rolling mill scheme failed are explained. P.E.C.

Wealden glass: The old Surrey-Sussex industry. S. E. WINBOLT. *Jour. Soc. Glass Tech.*, **16** [63], 254–71 (1932).—The names and positions of 27 sites of old glasshouses in northwest Sussex and southwest Surrey are given extending over an area of about 10 square miles. The reasons why Frenchmen settled here are discussed. The

known history of glassmakers from 1226 to about 1600 is briefly sketched. The materials used in medieval glassmaking are cited and details given of crucibles, blowpipes, glasshouses, furnaces, etc. A description is given of the types of glass found on the sites, both vessels and window. The question of the manipulation of colored glass is discussed, and the conclusion is reached that, with rare exceptions, it was not made here until the early 16th Century; colored glass was nearly all imported. A rough chronological classification of types of glass is attempted. Places where specimens of glass remains, etc., may be seen, are listed. G.R.S.

Ravenscroft glass. J. MCCORMACK. *Connoisseur*, **90** [375], 321 (1932).—No specimen of Ravenscroft drinking glass is known but one of the improved variety is illustrated. The glass is translucent although peppered with grains of white sand and evidencing the use of considerable niter tartar and borax. There is an identifying tear or raven's head in the stem and a refund was promised on any glass that crizzled. E.B.H.

Venetian glass industry. ANON. *Nat. Glass Budget*, **48** [26], 15 (1932).—The Italian glass industry is mainly concentrated in the province of Venice where three chief types of glassware are produced, *viz.*, (*a*) "vetrobianco" (white glass), which includes the ordinary white glass, neutral glass, panes, mirrors, and crystal glass; (*b*) jet and bead glass; and (*c*) artistic and fancy glass. The industry employs 3092 workmen normally, but at present about one-third are unemployed. E.P.R.

Modern glass. ANON. *Pottery Gaz.*, **57** [666], 1495 (1932).—A brief discussion of some new pieces of Brierly glass produced by Stevens & Williams, Ltd., from designs by Keith Murray, is presented. Illustrated. E.J.V.

Solarium in new steel dwelling. ANON. *Amer. Glass Rev.*, **52** [2], 19–20 (1932).—The Libbey-Owens-Ford Glass Co., Toledo, has been working in coöperation with the Insulated Steel Floor & Wall Co. of Cleveland and the American Rolling Mill Co. in the development of a frameless steel house, on the roof of which is a solarium of polished plate glass. See also *Ceram. Abs.*, **11** [11], 554 (1932). E.P.R.

New glass brick structure. OWENS-ILLINOIS GLASS CO. *Ceram. Ind.*, **19** [5], 242 (1932).—A new six-sided glass brick is described. Its prospective uses are numerous. W.W.M.

French glass for building. ANON. *Christian Sci. Mon.*, **24** [305], 1 (1932).—An armor-plate glass, produced by giving ordinary glass a special treatment, while retaining the transparency and weathering properties of ordinary glass will stand a dead load three to four times as great as that necessary to fracture ordinary plate glass. When it does break it shatters into tiny fragments. E.J.V.

Designing for construction in glass. I. EUGENE CLUTE. *Pencil Points*, **13** [11], 741–49 (1932).—America has a few examples of glass building construction. The old objections of fragility, heat loss, and lack of privacy have been overcome by modern scientific properties and methods. This article discusses data necessary for designing a roof, glass-block windows, building entrances, and a ceiling. Illustrated. E.B.H.

Aluminum as window "glass" in Germany. ANON. *Amer. Glass Rev.*, **52** [2], 22 (1932).—Aluminum window panes are being manufactured in Germany which are said to be so transparent that they may be used as glass. The aluminum eliminates the yellow rays of the sun. E.P.R.

Glass. ANON. *Pottery Gaz.*, **57** [666], 1502 (1932).—Two sketches depicting the supposed discovery of glass by Phœnician merchants and a modern hand-blowing operation are presented for comparison. E.J.V.

Glasses of Islamic ages. C. J. LAMM. *Nat. Glass Budget*, **48** [19], 8 (1932); for abstract see *Ceram. Abs.*, **11** [5], 302 (1932). E.P.R.

BOOKS, BOOKLET, AND BULLETIN

Progress Report of the Joint Committee on Illuminating Glasses of the Illuminating Engineering Society, the Illuminating Glassware Guild, and the Glass Division of the American Ceramic Society. 21 pp. Introduction by H. H. BLAIR. B. gives the needs and purposes of the organization. The scope of investigations, definitions of light-diffusing glass, and representative types of diffusing glasses are treated. Nomenclature of illuminating glasses is outlined by A. B. Oday, E. A. Richardson, and R. R. Shively. A classification of illuminating glasses is made by W. F. Little and O. P. Meaker. The groups treated are (1) highly diffusing opal, cased opal, and enameled glasses, (2) opalescent and alabaster glasses, (3) all other transparent and obscuring clear glasses, (4) prismatic controlling glasses, (5) decorative glasses, and (6) opaque glasses. Classification and tests (illuminating standpoint) are shown in a table. Studies of tests and data on the properties of illuminating glasses by W. F. Little, C. S. Woodside, and O. P. Meaker cover measurement of (1) diffusion, (2) obscuring power, (3) trans-

mission, (4) reflection factor, (5) absorption factor, (6) efficiency, and (7) test data on illuminating glasses. G. R. SHELTON

Treatise on Optical Pyrometry. (Traité de Pyrometrie Optique.) G. REBAND. xvi + 488 pp. 163 illustrations. Published by Rev. d'Optique, Paris, 1931. Reviewed in *Jour. Soc. Glass Tech.*, **15** [59], 347–48 (1931).—This treatise is a comprehensive, well ordered, and up-to-date survey of methods of measuring temperature which involve the measurement of radiation, visible or invisible. Thorough treatment is given to the exposition of the laws of radiation and of fundamental principles on which instruments for the measurements of high temperatures are based. G.R.S.

Booklet on colors shows use of vitrolite in modern homes. VITROLITE CO. *Amer. Glass Rev.*, **51** [49], 19 (1932).—In the interest of the use of its product in bathrooms and kitchens, the Vitrolite Co., Chicago, has issued an illustrated booklet. E.P.R.

Publications from the Kaiser Wilhelm Institute for Silicate Investigation. Vol. 4. (Veröffentlichungen aus dem Kaiser Wilhelm Institut für Silikatforschung in Berlin-Dahlem.) W. EITEL. F. Vieweg, Braunschweig, 1931. 38.50 M. *Naturwissenschaften*, **20** [40], 744 (1932).—Some of the reports reprinted here include (1) "photoelectric measurements of transparency and color purity of optical glasses," (2) "photoelectric procedure for making absorption curves of colored glasses," and (3) "structure of β-Al_2O_3." See also *Ceram. Abs.*, **10** [10], 740 (1931). L.T.B.

PATENTS

Process for making composite glass. E. L. FIX AND M. L. MACHT (Duplate Corp.). U. S. 1,887,550, Nov. 15, 1932. J. H. SHERTS (Duplate Corp.). U. S. 1,887,565, Nov. 15, 1932.

Plate glass polishing apparatus. H. K. HITCHCOCK (Pittsburgh Plate Glass Co.). U. S. 1,887,554, Nov. 15, 1932.

Process for severing composite glass. J. H. SHERTS (Duplate Corp.). U. S. 1,887,564, Nov. 15, 1932.

Apparatus for aligning molds of glassware forming machines. E. H. LORENZ (Hartford-Empire Co.). U. S. 1,888,199, Nov. 15, 1932.

Mechanism for forming hollow-glass articles. V. E. HOFMANN (Owens-Illinois Glass Co.). U. S. 1,888,318, Nov. 22, 1932.

Composite silica article. G. A. F. WINCKLER (General Electric Co.). U. S. 1,888,341, Nov. 22, 1932.

Process for pushing glass bottles. EMILE ROIRANT (Soc. anon. d'études et de constructions d'appareils mécaniques pour la verrerie). U. S. 1,888,393, Nov. 22, 1932.

Glassworking machine. E. E. SLICK. U. S. 1,888,396, Nov. 22, 1932.

Continuous two-table glassware forming machine. A. J. SMITH (Hartford-Empire Co.). U. S. 1,888,438, Nov. 22, 1932.

Oscillating glassware transfer. THOMAS WAUGH, JR. (Hartford-Empire Co.). U. S. 1,888,440, Nov. 22, 1932.

Continuous tank furnace. E. T. FERNGREN (Libbey-Owens-Ford Glass Co.). U. S. 1,888,496, Nov. 22, 1932.

Apparatus for washing sheet glass. J. C. GIPE AND J. P. CROWLEY (Libbey-Owens-Ford Glass Co.). U. S. 1,888,498, Nov. 22, 1932.

Device for feeding glass articles. J. F. DONOVAN AND GEORGE ILLINGWORTH (General Electric Co.). U. S. 1,888,851, Nov. 22, 1932.

Glassfeeding method and apparatus. K. E. PEILER (Hartford-Empire Co.). U. S. 1,888,963, Nov. 22, 1932.

Manufacture of corrugated wire glass. ARNO SHUMAN (Pennsylvania Wire Glass Co.). U. S. 1,888,965, Nov. 22, 1932.

Take-off and conveyer mechanism for intermittent sheet-glass forming machines. EUGENE GENTIL (American Bicheroux Co.). U. S. 1,889,065, Nov. 29, 1932.

Method of producing revivified ultra-violet transmitting glasses. H. P. HOOD (Corning Glass Works). U. S. 1,889,067, Nov. 29, 1932. The method of restoring the property of ultra-violet transmission to ultra-violet transmitting glasses that have lost their property of transparency to certain ultra-violet radiation consists in heating them to a temperature approximating their annealing temperature.

Roller conveyer for glass plates. LAMBERT VON REIS (American Bicheroux Co.). U. S. 1,889,082, Nov. 29, 1932.

Rotary tank. W. O. AMSLER (Hartford-Empire Co.). U. S. 1,889,509, Nov. 29, 1932.

Apparatus for melting glass. W. O. AMSLER (Hartford-Empire Co.). U. S. 1,889,510, Nov. 29, 1932.

Rotary glassmelting furnace. W. O. AMSLER (Hartford-Empire Co.). U. S. 1,889,511, Nov. 29, 1932.

Method of forming electrode for use in melting furnaces. H. W. MCINTOSH (Hartford-Empire Co.). U. S. 1,889,516, Nov. 29, 1932.

Method and apparatus for making glass tubing and rods. P. A. FAVRE. U. S. 1,889,891, Dec. 6, 1932.

Apparatus for making plate glass. J. H. FOX (Pittsburgh Plate Glass Co.). U. S. 1,890,322, Dec. 6, 1932.

Process and apparatus for grinding glass. T. H. SWARTZLANDER (Pittsburgh Plate Glass Co.). U. S. 1,890,343, Dec. 6, 1932.

Rolling composite glass strips. HARRY SMITH (Pilkington Bros., Ltd.). U. S. 1,891,116, Dec. 13, 1932.

Compound safety-glass sheets or plates. J. TALBOT AND F. BOWIE. Brit. 382,491, Nov. 2, 1932.

Apparatus for handling glassware. BRITISH HARTFORD-FAIRMONT SYNDICATE, LTD. Brit. 382,599, Nov. 2, 1932.

Manufacture of glass flower blocks, etc. T. DAVIDSON. Brit. 382,699 and 382,902, Nov. 9, 1932.

Method for producing glasspots and glass cuvettes. M. HOLLENWEGER. Brit. 382,923, Nov. 9, 1932.

Manufacture of glass tubes, etc. NAAMLOOZE VENNOOTSCHAP MIJ. TOT BEHEER EN EXPLOITATIE VAN OCTROOIEN AND L. S. VELLO. Brit. 383,146, Nov. 16, 1932, and 383,521, Nov. 23, 1932.

Process of manufacturing glass. T. GOLDSCHMIDT AKT.-GES. Brit. 383,186, Nov. 16, 1932.

Manufacture of nonsplinterable lenses and other forms of nonsplinterable or laminated glass. W. WILLIAMS AND INVESTORS MANAGING TRUST, LTD. Brit. 383,696, Nov. 30, 1932.

Machines for producing hollow glassware. O. EVANS (Europäischer Verband der Flaschenfabriken Ges.). Brit. 383,910, Nov. 30, 1932.

Process for the manufacture of double-walled glass vessels. GLASFABRIK SOPHIENHÜTTE R. BOCK G.M.B.H. Brit. 383,951, Nov. 30, 1932.

Structural Clay Products

Reinforced brick masonry proves its practical value. HUGO FILIPPI. *Brick Clay Rec.*, **81** [5], 159–61 (1932).—The first practical, full size field tests of reinforced brick masonry, made by R. W. Hunt Co., Chicago, proved that reinforced brick masonry is practical, adaptable, and structurally safe in actual building construction. Three structures were designed by F. Number 1, designed to carry 50 lb./sq. ft., actually carried 237½ lb. without failure. The 2¼-in. floor slab carried 600 lb./sq. ft. before failing. Number 2, designed for 75 lb., held a load of 407 lb./sq. ft. before failing. The floor slab in this structure failed at 680 lb. Number 3, designed for 100 lb., failed at 480 lb./sq. ft. and the floor slab finally failed at 654 lb. Illustrated. E.J.V.

Lightweight brick. GEO. B. KISSINGER. *Clay-Worker*, **98** [5], 193 (1932).—A brick with voids in the lower bearing face gives an uninterrupted bed for mortar, has the same appearance as the solid brick when placed in the wall, and reduces the weight 20 to 25%. Illustrated. E.J.V.

Lightweight brick. ANON. *Popular Sci. Monthly*, **120** [4], 62 (1932).—A lightweight brick developed by Charles F. Burgess, American chemist, is described. Illustrated. F.G.H.

Large-size hollow tile with slot-shaped holes. O. HARTMANN. *Tonind.-Ztg.*, **56** [86], 1066–67 (1932).—Different types of tile are described with vertical, horizontal, and diagonal slots or a combination of these. It is pointed out that not more than 76% can be utilized in comparison to a solid brick. Illustrated. See also *Ceram. Abs.*, **11** [3], 177 (1932). W.M.C.

Hard-fired brick for road construction. ANON. *Tonind.-Ztg.*, **56** [88], 1089–90 (1932).—This is a discussion of the proposals for a standardization of hard-fired brick for road construction as outlined before (see *Ceram. Abs.*, **11** [12], 615 (1932) and following abstract). W.M.C.

Standardization of hard-fired brick for road construction. DIESKAU. *Tonind.-Ztg.*, **56** [90], 1110 (1932).—This is a further discussion of this subject. See also *Ceram. Abs.*, **11** [9], 490 (1932). W.M.C.

Dutch clays for manufacturing hard-fired brick. H. HIRSCH. *Tonind.-Ztg.*, **56** [83], 1029 (1932).—Many clays used for manufacturing hard-fired brick in Holland contain rather large amounts of lime. By careful handling, however, satisfactory products are obtained. Chemical composition, rational analysis, shrinkage at different temperatures, and porosity are given for three typical clays. W.M.C.

Swedish standard specifications for brick. ANON. *Tonind.-Ztg.*, **56** [84], 1044–45 (1932).—New standard specifications for common, hard-fired, and porous brick of different brands are reviewed. Special tests are prescribed for determining the unit weight, strength, freezing behavior, etc., of the products. W.M.C.

German and Swedish standard specifications for brick. H. HIRSCH. *Tonind.-Ztg.*, **56** [86], 1064 (1932).—The standard specifications of the two countries are compared. The Swedish specifications for hard-fired brick provide higher values than the German ones. W.M.C.

Deterioration of domestic chimneys. I. J. E. MACONACHIE. *Can. Chem. Met.*, **16** [11], 270–74 (1932).—A field survey of chimney deterioration showed the two following reasons for rapid deterioration: (1) the inferior workmanship of construction, and (2) it was considered likely that flue-gas condensate was reacting with the constituents of the brick and mortar to form a solution of sulfates which was carried to the outside of the wall by capillarity, depositing crystallized salt wherever drying was sufficient; the mortar was being destroyed by the crumbling effect of the crystallization of calcium sulfate within its mass as well as by the leaching action of the acid solution. Conditions bearing on condensation, flue-gas compositions, chimney temperatures, and dew-point determinations were studied. Raising the chimney temperatures, lowering the dew-point, and using protective coatings were tested as methods of preventing deterioration. Simulative service tests on wallettes were also made. Some of the results are given graphically. Illustrated. E.J.V.

Face brick in the large buildings. ROBERT L. KETCHAM. *Clay-Worker*, **98** [5], 184–86 (1932).—In discussing the possibilities of increasing large sales of face brick in the metropolitan areas, K. stresses the advisability of the manufacturers adhering to two things, a suitable style of product and a proper course of sales activity, particularly in respect to dealer relations. E.J.V.

Brick in the future. RALPH T. KLEYMEYER. *Clay-Worker*, **98** [5], 194–95 (1932).—The advantages of brick as a building material are pointed out and the adverse criticisms are answered. If brick are replaced by new materials it will be due to lack of salesmanship on the part of the brick industry rather than to the excellence of the other products. E.J.V.

Small house of the future. L. E. OLSON. *Clay-Worker*, **98** [5], 186–87 (1932).—It is pointed out that the best, though not quite the cheapest, form of construction for small houses is that with masonry exterior walls, solid, or veneer on wood or steel frame. The results of a national survey of the type house demanded by women are discussed. E.J.V.

Two small brick houses. ANON. *Tonind.-Ztg.*, **56** [85], 1054–55 (1932).—These houses were built with large-sized tile of the types "National" and "Ludowici." Illustrated. W.M.C.

Adobe brick, Mexican style. H. J. B. *Christian Sci. Mon.*, **25** [4], 6 (1932).—A detailed description of a California dwelling made of adobe brick, 18 x 12 x 4 in., baked in the sun, and cemented with moist adobe as mortar, is given. Illustrated. E.J.V.

Building trades exhibition. ANON. *Times Eng. Supp.*, **31**, 7–11 (1932).—A feature of the Olympia exhibition in London was the welcome coöperation between manufacturer and architect in the artistic design and color tone of the stands. H.H.S.

New schemes of brick selling. W. HERRICH. *Tonind.-Ztg.*, **56** [90], 1108–1109 (1932).—The advantages of coöperation for brick and tile manufacturers are outlined. W.M.C.

Brick plant packing troubles. W. F. SCHAPHORST. *Clay-Worker*, **98** [5], 202 (1932).—To overcome packing troubles due to expansion or contraction of the packing, a so-called "metallic packing" which neither expands nor contracts with change in temperature and resists corrosion from acids, alkalis, and electrolysis is recommended. E.J.V.

Modern sand-lime brick factories. ALBERT BEHNISCH. *Eng. Progress*, **13** [11], 244–46 (1932).—A sand-lime brick plant recently constructed near Moscow, U.S.S.R., is described. Illustrated with drawings and photos. J.L.G.

BOOK

Annual Report (1931) of the Building Research Board. GEORGE HUMPHREYS AND R. E. STRADLING. H. M. Stationery Office, London, 1932. Price 3s. Reviewed in

Times Eng. Supp., **31**, 20 (1932).—The work is described under the main headings of weathering, materials, structures, and efficiency of buildings from the user's viewpoint. H.H.S.

PATENTS

Building tile. H. E. STEVENS (D. A. Stevens). U. S. 1,887,701, Nov. 15, 1932.

Process and apparatus for forming face brick. S. C. DUTY. U. S. 1,888,376, Nov. 22, 1932.

Brick molding. D. J. STRICKLAND (H. P. Ramsdell). U. S. 1,888,398, Nov. 22, 1932.

Tunnel or conduit lining. J. F. O'ROURKE. U. S. 1,889,563, Nov. 29, 1932.

Masonry wall and wall unit. E. W. RANCK. U. S. 1,889,699, Nov. 29, 1932.

Floor system. F. D. STURGES (Jones & Laughlin Steel Corp.). U. S. 1,890,921, Dec. 13, 1932.

Joist and tile construction for floors, etc. H. F. FREASE. U. S. 1,891,086, Dec. 13, 1932.

Tongue and groove building block. W. LUDOWICI AND GENEBA GES. FÜR NEUE BAUWEISEN. Brit. 382,447, Nov. 2, 1932.

Building brick, blocks, etc. G. H. C. RATCLIFFE AND LONDON BRICK CO. & FORDERS, LTD. Brit. 383,774, Nov. 30, 1932.

Refractories

Symposium on the physical chemistry of the alumina-silica refractories. I. "Physical chemistry" of a system of refractory components. ROBERT B. SOSMAN. *Jour. Amer. Ceram. Soc.*, **16** [1], 54–57 (1933). **II. The clay minerals.** C. S. ROSS AND P. F. KERR. *Ibid.*, pp. 57–58. **III. Minerals with the composition, $Al_2O_3 \cdot SiO_2$.** HERBERT INSLEY. *Ibid.*, pp. 58–60. **IV. Equilibria in the system, alumina–silica.** ROBERT B. SOSMAN. *Ibid.*, pp. 60–68. **V. Behavior of unstable or monotropic forms in the system, alumina–silica, and related systems.** ALBERT B. PECK. *Ibid.*, pp. 68–75. **VI. Kaolins: effect of firing temperature on some of their physical properties.** R. A. HEINDL, W. L. PENDERGAST, AND L. E. MONG. *Ibid.*, pp. 75–76.

Manufacture of electrocorundum and silicon carbide. R. SCHNEIDLER. *Feuerfest*, **8** [9], 129–32 (1932).—Aluminum oxide or alumina exists in 3 different crystallographic modifications: (1) the α-alumina (corundum) stable at high temperatures, (2) the metastable γ-alumina with a stability range up to 930°, and (3) the β-form. The alumina of the α-form and γ-form differ in that the γ-alumina is mostly amorphous, while corundum (α-alumina) forms aggregates with crystals besides having different physical properties. Electrocorundum is a crystallized α-aluminum oxide free from water and is produced in an electric arc furnace. It differs from artificial corundum (cupola furnace method, Thermit method) and natural corundum of purest form (ruby and sapphire). The manufacture of artificial corundum consists morphologically in a conversion of the amorphous α-alumina into the crystalline α-form at over 930°. The raw materials used for it are white and red bauxites, emery, and kaolin. Amorphous alumina of great purity is used for corundum of the highest alumina content. Silicon carbide is a pure artificial product and is formed from its components, silica and coal, in an electric resistance furnace. Patent literature dealing with the manufacture of corundum and silicon-carbide refractories is discussed. M.V.K.

Diatomite insulating constructions. ANON. *Ind. chimique*, **19** [223], 625 (1932).—The joints between insulating diatomite brick must be filled up with special cement which differs from ordinary cement only in that the sand is replaced by pulverized diatomite. A mixture composed of 80% diatomite and 20% Portland cement is recommended. If the brick are used as refractories, the diatomite of the mortar should be calcined first as its softening point lies considerably higher than that of raw diatomite. M.V.K.

Highly refractory dolomite brick. ANON. *Feuerungstechnik*, **20** [9], 141 (1932).—The tendency to crack of refractory products having dolomite or lime as the chief constituent and mixed with tar or pitch as a bonding agent is due to certain ingredients of the tar or pitch. This disadvantage does not appear when the dolomite or fired lime is mixed with a small quantity of naphthalene or anthracene, or with a substance consisting chiefly of naphthalene or anthracene according to the patented method of H. Hageman. Anthracene oil is obtained from coal tar. When it is used, a very small amount of gas is developed and no slag is left to clog up the way of the escaping gases and so produce cracks in the brick. The brick produced is free from cracks and can be fired after pressing without a preliminary air drying. Sometimes a special firing is not necessary and

the raw brick are used in the construction of the furnace. The firing of the brick takes place later during the operation of the furnace. M.V.K.

Firing fire brick. ANON. *Refrac. Bull.*, No. 6 (1932); abstracted in *Refrac. Jour.*, **8** [9], 360 (1932).—An accurate conception of the major reactions is presented diagrammatically. The percentage expansion and contraction of a fire clay is plotted against rising temperature and vertical lines separate the stages within which definite changes occur. The first effect of heat is to expel moisture from the clay, the second is the breakdown of the kaolinitic material, and the third reaction is connected with the oxidation and removal of carbon and sulfur from the clay. An illustration shows the setting of fire brick in a tunnel kiln in which complete control of the firing can be maintained. E.P.R.

Fire brick with more than 90% grog. W. HUGILL AND W. J. REES. Discussed in *Jour. Indian Ceram. Soc.*, **3** [3], 110–15 (1931); for abstract of original article see *Ceram. Abs.*, **11** [11], 572 (1932); see also O. V. Tereshtschenko and S. I. Perkal, *ibid.*, **12** [1], 21 (1933). A.A.

Grog brick. J. ROBITSCHEK. *Feuerfest*, **8** [10], 145–49 (1932); for abstract see *Ceram. Abs.*, **11** [11], 572 (1932). M.V.K.

Quality of grog in dependence on the working method. V. P. ZUBCHANINOV. *Stroitel. Material.* [Moscow], No. 5, pp. 65–71 (1932); abstracted in *Feuerfest*, **8** [9], 141 (1932). M.V.K.

Drying magnesite brick; volume changes accompanying hydration. J. H. CHESTERS AND W. WEYL. *Colliery Guard.*, **145** [3744], 646 (1932); for abstract see *Ceram. Abs.*, **11** [12], 619 (1932). E J.V.

Super refractories. A. GRANGER. *Céram. Verrerie*, No. 838, pp. 189–92; No. 839, pp. 245–48; No. 840, pp. 301–304 (1932).—G. considers all materials having a fusion point higher than that of dehydrated kaolinite (cone 35) as super refractories. In this class are included the anhydrous aluminum silicates, hydrated aluminates, natural and artificial corundum, chrome, the RO_2 group including zirconia and thoria, the RO group, of which magnesia and beryllia are important, graphite and silicon carbide, and the nitride and carbide of boron. The uses, characteristics, composition, and preparation of these materials are discussed in detail. M.H.B.

Some experiments with zircon and zirconia refractories. GEORGE F. COMSTOCK. *Jour. Amer. Ceram. Soc.*, **16** [1], 12–35 (1933).

Melting points of zirconium and hafnium oxides. P. CLAUSING. Abstracted in *Metals & Alloys*, **3** [10], 313 (1932); for abstract see *Ceram. Abs.*, **11** [8], 471 (1932). E.P.R.

Influence of cyanogen on the reduction of carbon monoxide in contact with refractory materials. H. W. HIBBOTT AND W. J. REES. *Refrac. Jour.*, **8** [10], 368–78 (1932); for abstract see *Ceram. Abs.*, **12** [1], 20 (1933). E.P.R.

Permeability of refractory materials. III. Influence of the firing process on the permeability to air of fireclay materials. F. M. CLEWS AND A. T. GREEN. Brit. Refrac. Research Assn. *Bull.*, **28**, 1–15 (1932); abstracted in *Power Fuel Bull.*, **21**, 131 (1932). **IV. Experiments at temperatures up to 850°C.** Brit. Refrac. Research Assn. *Bull.*, **28**, 16–27 (1932); abstracted in *Power Fuel Bull.*, **21**, 131 (1932). For Parts I and II see *Ceram. Abs.*, **11** [9], 493 (1932). W.E.R.

Melting diagrams of refractory oxides. V. Systems with MgO. H. v. WARTENBERG AND E. PROPHET. *Z. anorg. allgem. Chem.*, **208** [4], 369–79 (1932).—The melting temperatures of refractory oxides in systems containing MgO were studied. The following systems were studied: MgO with Cu_2O, BaO, CaO, SrO, BeO, ZnO, Al_2O_3, TiO_2, SiO_2, ZrO_2, CeO_2, ThO_2, Cr_2O_3, Mn_3O_4, Fe_3O_4, NiO, and CoO. The melting points of NiO (1990°), CoO (1810°), and Mn_3O_4 (1560°) were accurately determined. The melting points of $2TiO_2 \cdot MgO$ and $2MgO \cdot TiO_2$ were redetermined at 1680 and 1840°, respectively. Because of the small ionic radius of Mg, only a few oxides will show a tendency toward solid solution formation, *i.e.*, NiO, CoO, Mn_3O_4, Fe_3O_4, and Cr_3O_4. **VI. Corrections.** H. v. WARTENBERG AND H. J. RAUSCH. *Z. anorg. allgem. Chem.*, **208** [4], 380–81 (1932).—Some corrections to melting points which were reported formerly in this series are given. For Part IV see *Ceram. Abs.*, **11** [11], 575 (1932). L.T.B.

Combined testing methods. V. SKOLA. *Sprechsaal*, **65** [21], 391 (1932); *Feuerfest*, **8** [5], 78 (1932); see also *Ceram. Abs.*, **11** [11], 575 (1932). M.V.K.

Specifications and methods of test for refractory materials and manual for interpretation of refractory test data. A.S.T.M. *Clay-Worker*, **98** [3], 114 (1932); *Fuels & Fur.*, **10** [8], 552 (1932); for abstract see *Ceram. Abs.*, **12** [1], 24 (1933). E.J.V.

German standard specifications for refractory products. E. H. SCHULZ AND F. HARTMANN. *Stahl & Eisen*, **52** [41], 905–98 (1932).—This is a review of the German

standard specifications up to 1932. This review covers mainly refractories for the steel industry and gives in detail the standards for testing methods, quality standards, and standards of sizes and shapes. W.M.C.

Dehydration of bauxites and bauxite minerals. J. GYÖRKI. Abstracted from *Földtani Közlony*, LXI (1931); *Sprechsaal*, **65** [43], 776 (1932).—Hydrargillite ($Al_2O_3 \cdot 3H_2O$), diaspore ($Al_2O_3 \cdot 1H_2O$), limonite, and kaolin ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$) were subjected to dehydration experiments. It was found that the different materials show similar curves of dehydration. On the basis of the curves obtained, G. discusses the constitution of these minerals. M.V.K.

Drying bauxite. J. FINKEY. Abstracted in *Ind. chimique*, **19** [220], 354 (1932); for abstract see *Ceram. Abs.*, **11** [7], 414 (1932). M.V.K.

Study of the flotation of bauxites from the Bodayk deposits (Hungary). A. LOTTERMOSER AND H. RUMPELT. Abstracted in *Ind. chimique*, **19** [225], 749 (1932); for abstract see *Ceram. Abs.*, **11** [11], 574 (1932). M.V.K.

Researches on beryllium. H. A. SLOMAN. *Metal Ind.* [London], **41** [16], 369–72; [17], 397–400; [18], 417–18 (1932).—S. describes in detail investigations made on beryllium. The temperature of melting and subliming was about 1900° and the refractory crucibles used were made from beryllia, alumina, magnesia, and thoria. For avoiding the contamination of the beryllium by other metals, beryllia had enormous advantages, but the comparatively ready solubility of beryllium oxide in the molten metal is objectionable. Beryllium was also melted *in vacuo* in a pure alumina crucible in a high-frequency induction furnace. Reduction of alumina by beryllium occurs in accordance with the reaction $3Be + Al_2O_3 \rightleftarrows 3BeO + 2Al$. Similar experiments were conducted using pure magnesia crucibles. A trace only of magnesium was found in the metal. The amount of the eutectic impurity, however, had increased considerably. Owing to the high cost of thoria, the crucible used in the experiment was made of alumina with a thoria lining. Reduction occurred to a larger extent than in either of the two previous cases: $2Be + ThO_2 \rightleftarrows 2BeO + Th$. The resulting metal was brittle and dense having a thorium content of about 33% by weight (about 16 atomic per cent). M.V.K.

Coal dust. ANON. *Refrac. Jour.*, **8** [10], 362 (1932).—Recent research work has shown that suitable additions of coal dust to molding sand can be relied upon to stop scabbing, the reason being that on the approach of the molten iron the particles of coal exude tarry matter which binds the sand grains together and holds them in position. E.P.R.

Utilization of Semis-Bugu corundums for high-grade refractories. E. KELER. *Trans. Ceram. Research Inst.* [Leningrad], No. 34, pp. 20–41 (1932).—K. describes attempts made to use powdered corundum for the manufacture of refractory products. The results were as follows: (1) The refractoriness of the products amounted to Seger cone 39. (2) The softening under load of 2 kg./sq. cm. began at 1420 to 1500°; for products fired to Seger cone 26 or 32, the softening began between 1525 and 1630°. A complete softening appeared at about 1670° (for some samples, 1710°). The products shrink very little with increased temperature; their capability of absorbing water at Seger cone 12 or 14 amounted to from 10.7 to 17.8%. (3) The sensitivity to changes of temperature was determined. The stability to changes of temperature of corundum products is similar to that of grog products of high grade. (4) The resistance to the attack of slag was shown to be high and considerably higher than that of grog brick with a high alumina content. (5) A microscopical investigation of the products of (4) showed that they did not contain any mullite crystals and that their chemical resistance is due to corundum crystals. M.V.K.

Refractory mortar. C. OTTO & CO. *Refrac. Jour.*, **8** [10], 404 (1932); for abstract see *Ceram. Abs.*, **11** [10], 534 (1932). E.P.R.

Slag studies with special regard to slag containing manganese. C. W. CARSTENS AND K. R. KRISTOFFERSEN. *Neues Jahrb. Mineral Beil-Bd.*, **62A**, pp. 163–95 (1931); abstracted in *Glastech. Ber.*, **9** [4], 238 (1931).—Different kinds of manganese slag were examined and analyzed; the presence of spinel crystals, brown glass, and modifications of silicon carbide and other minerals was determined. M.V.K.

Heat insulation and refractories for high-temperature work. R. HADFIELD AND R. J. SARJANT. *Fuel Econ. Rev.*, **11**, 119–26 (1932); abstracted in *Power Fuel Bull.*, **19**, 98 (1932).—After a general review of the progress of heat insulation, fluctuating heat flow is discussed. W.E.R.

Foundry refractories. J. R. ALLAN. Abstracted in *Metals & Alloys*, **3** [10], 313 (1932); see also *Ceram. Abs.*, **11** [7], 416 (1932). E.P.R.

Experiments with special refractory products for lining electric kilns. F. SOMMER.

Stahl & Eisen, **52** [41], 897–901 (1932).—Experiments were carried out to use a tar-dolomite mortar and the same type of brick for lining the crowns of different types of electric and arc furnaces. Further experiments were made with fired tar-dolomite brick. All these linings proved to be unsatisfactory. The use of carbon brick as a lining gives satisfactory insulation against heat radiation and a considerable saving of energy. These savings are balanced, however, by the more frequent need of repair of the lining. Experiments with a ripped crown made of silica brick showed superior durability, but no saving was realized as the costs of energy increased. Similar experiences at other places are mentioned. Chrome-magnesite brick also give satisfactory results. W.M.C.

Contribution to the technology of tar for steelworks. R. FRANÇOIS. *Chim. & ind.*, **27** [4], 780–84 (1932).—Tar used as a bonding agent of dolomite for lining Thomas converters and Martin furnaces must have special qualities, *i.e.*, (1) it must be agglomerating, (2) it must be distilled according to a regular curve, (3) it must produce a coke residue as large as possible, and (4) it must have a constant composition. The life of the lining is a function of 3 factors, (1) quality of the tar, (2) nature of the dolomite used, and (3) composition of the cast metal. The methods used for manufacturing tar for steelworks are (1) the dry distillation, (2) the mixing method, and (3) direct and continuous manufacture. Conclusions are that the former methods used by the tar industry were difficult because of the necessity of eliminating only one element, naphthalene, without removing the other materials. The method of distillation by steam greatly simplified the whole process. M.V.K.

Refractory materials and the nonferrous industries. A. B. SEARLE. *Refrac. Jour.*, **8** [10], 362 (1932).—S. explains in some detail the nature of "refractoriness." The effect of pressure, reducing conditions, and other changes in environment were also described. The incompatibility of refractoriness, mechanical strength, and resistance to corrosion is shown. The subjects of spalling, flaking, corrosion by slag, and destruction by abrasion are also considered. In conclusion, a summary of the chief future developments which are to be anticipated in the use of refractory materials in the nonferrous industries is given. E.P.R.

Blast-furnace linings. W. J. REES. *Trans. Ceram. Soc.* [Eng.], **31** [9], 317–34 (1932); see also *Ceram. Abs.*, **12** [1], 21 (1933). C.G.H.

Refractory baffle. ANON. *Manchester Guard. Supp.*, **8** [27], 178 (1932); abstracted in *Refrac. Jour.*, **8** [9], 360 (1932).—Reference is made to the utility of the refractory baffle in oil burning with cylindrical boilers. The refractory baffle of fire brick or molded refractory materials serves a double purpose by increasing the temperature of combustion and by preventing the through passage of the products of combustion. The importance of refractory baffles in heat-transfer problems is emphasized. E.P.R.

Failure of blast-furnace linings. C. L. BEATTIE. *Iron Coal Trades Rev.*, **124** [3337], 273–74 (1932).—Excessive wear occurs in linings of blast furnaces at a point about 15 to 20 ft. above the bosh and extending 10 to 25 ft. higher. In the Middlesborough district, using Cleveland ores, linings gave an average output of 600,000 t. when furnaces produced 650 to 800 t. per week, 500,000 t. at 1000 to 1200 t. per week, and less than 250,000 t. at 1500 t. per week. Observations indicated that destruction of the brickwork was caused by the high alkaline content of the gases. Analysis of material that condensed to the liquid state in the furnace at 780°C was sodium carbonate 15.55%, potassium carbonate 50.03, potassium hydrate 20.70, lime 1.00, iron oxide and alumina 4.40, silica, etc., 8.32. The trouble was minimized by (1) reduction of size of iron ore to 5-in. cubes and less; (2) use of standard brick instead of fireclay blocks because the brick offer better facilities for pressing and firing and give better joints; (3) use of good quality coke; and (4) insertion of water-cooled blocks at the zone of highest temperature and velocity of gases whereby a protective layer of carbon bonded together by the alkaline constituents impervious to the alkaline gases is formed on the brick. The use of water-cooled blocks did not lower the efficiency of the furnace. W.E.R.

Rapid wear of blast-furnace shafts. Method of cooling. A. COUSIN. *Rev. Mét.*, **29** [2], 57–60 (1932).—C. discusses briefly the increased wear on blast-furnace shafts with the increasing loads of modern practice. He points out that maximum wear occurs about halfway up the shaft. The disadvantages of water cooling and the new method developed by the Cockerill Co. which is used with the system of "open" shaft reinforcement, also devised by this company, are described. A large number of holes is provided in the brickwork of the shaft and air at a pressure of 7 to 12 in. water is introduced through tubes leading nearly to the inner end of the holes. For a 300-ton furnace, with 1700 holes giving an apparent cooling surface of 1050 sq. ft., a fan with an output of 25,000 cu. ft./min. requiring 35 kw. for its operation is sufficient. With this method

the furnace has already lasted twice as long as the longest period previously recorded and so far shows no signs of wear. J.B.A.

Refractory coatings. L. LITINSKY. *Korrosion Metallschutz*, **7** [7], 165–67; [8], 195–201; [9], 210–16; [10], 243–49 (1931); *Refrac. Jour.*, **8** [9], 360 (1932); see also *Ceram. Abs.*, **11** [2], 114; [4], 247 (1932). J.B.A.

Suspended combustion chamber walls. ANON. *Chem. & Ind.*, **51** [38], 778–79 (1932); abstracted in *Power Fuel Bull.*, **21**, 133 (1932). W.E.R.

"Carborundum" crucibles. Published by the Carborundum Co. *Metal Ind.* [London], **41** [15], 350 (1932).—This material is an electric furnace product which does not melt or soften at any temperature and is only decomposed by the extreme heat of the electric furnace. It is an excellent conductor of heat, its thermal conductivity being about 9 times that of fire brick. Its coefficient of expansion is about one-third that of fire clay. The crucibles are unaffected by moisture and by the usual fluxes used in the melting of nonferrous metals. M.V.K.

Graphite crucibles. GROSSALMERODER SCHMELTZTIEGEL-WERKE. *Metal Ind.* [London], **41** [11], 257 (1932).—A crucible is being produced which can be exposed at once to temperatures of 1000°. The blast can be turned on full from the outset so that the melting process can be greatly accelerated. M.V.K.

Melting gray and malleable iron in the electric furnace. J. C. BENNETT AND J. H. VOGEL. *Foundry*, **60** [3], 35–38 (1932).—In the operation of an electric furnace for melting iron the greatest cost per ton of iron poured is chargeable to power. Refractories constitute the second largest cost. The figure for this expense includes the insulating lining, the refractory lining, both material and installation labor, and all patching labor and material. The method of patching the furnace lining is described in detail. A curve showing refractory cost per ton against tons of iron charged is plotted to determine at any time the status of the lining. The cost per ton is derived by dividing the total lining and patching cost to date by the total tons charged to date. This curve also indicates the need for relining, should this occur before the apparent total failure of the lining. Should the curve rise consistently, it indicates that the lining is in such poor condition that the excessive patching costs are increasing the refractory cost per ton. Therefore, relining is advisable even though the lining apparently is good. Illustrations and a refractory cost curve are presented. F.G.H.

Refractory building materials for glass furnaces. VLADIMAR SKOLA. *Glastech. Ber.*, **10** [9], 482–91 (1932).—Older procedures in the preparation of highly refractory materials for glass manufacture are discussed, and their displacement by cast, crystalline refractories is described. Corhart blocks are discussed in detail with regard to process of manufacture, properties, applicability, durability, and economy. W.W.B.

Factors affecting the life of glasspots. JOHN M. NEFF. *Ceram. Ind.*, **19** [6], 270–73 (1932).—N. discusses glasspot compositions, preparation of the raw materials, and manufacture of the pots. Cast pots can be made more cheaply and more quickly than handbuilt pots. Harder grog is used and more attention is being paid to cyanite, mullite, and andalusite refractories. An extremely corrosive barium glass is used in testing experimental formulas. The importance of the drying stage is emphasized and the procedure described. W.W.M.

Lining cement revolving furnaces. K. MELJUSCHEV. *Stroitel. Material.* [Moscow], No. 7, pp. 11–17 (1932); abstracted in *Feuerfest*, **8** [10], 158 (1932).—M. discusses the use of talc refractories. M.V.K.

Utilizing magnesite brick stable to temperature changes in the sintering zone of cement shaft and revolving furnaces. K. ENDELL. *Zement*, **21** [37], 522 (1932).—The chief requirements for the refractories used in the sintering zone of a modern revolving furnace are (1) chemical resistance to the attack of the raw cement powder at high temperature, and (2) temperature stability. Magnesite brick are highly resistant to the attack of the raw cement but have a poor resistance to sudden changes in temperature. Attempts to improve the latter quality have been successful, and technical experiments with such brick are described. See also *Ceram. Abs.*, **11** [12], 616 (1932). M.V.K.

Calculation of wall losses of industrial furnaces. E. MAASE. *Feuerfest*, **7** [10], 147 (1931); abstracted in *Metals & Alloys*, **3** [9], 280 (1932).—Diagrams are presented from which the losses due to thermal conductivity and gas permeability as well as the outside wall temperature can be taken directly. A graphical method of evaluating the temperature gradient of a wall consisting of two different materials is shown. The viewpoints essential for the calculation of the thermal conductivity of refractories are discussed. A table gives data on the thermal conductivity of various materials employed in furnace construction. See also *Ceram. Abs.*, **10** [12], 855 (1931). E.P.R.

Refractories for industrial furnaces. IV. F. H. NORTON. *Fuels & Fur.*, **10** [9], 575–84 (1932).—The thermal characteristics of heat flow and heat capacity of common types of refractories and insulators are discussed. Values of thermal conductivity, measurement of thermal conductivity, efficient use of furnace insulation, computation of the heat flow through insulated walls, the economy of insulation, construction of insulated walls, heat content of walls, recuperators, and some typical calculations are taken up. For Part III see *Ceram. Abs.*, **11** [12], 618 (1932). E.J.V.

"Siemensite" as a lining for open-hearth furnaces. J. SITTARD. *Stahl & Eisen*, **52** [42], 1014–17 (1932).—"Siemensite" is a new highly refractory material obtained by melting in an electric arc furnace under reducing conditions. The composition of the molten material is as follows: Cr_2O_3 20 to 40%, Al_2O_3 25 to 45%, MgO 18 to 30%, and the remainder 8 to 14%. The new material has been used in the most exposed places of the furnaces, such as burners, front and back walls, etc. Up to the present, this material has proved satisfactory and very economical. It still remains to be seen, however, whether it can be used for all purposes. W.M.C.

Recent developments in open-hearth furnace design. R. A. HACKING. *Jour. Soc. Glass Tech.*, **16** [63], 293–314 (1932); for abstract see *Ceram. Abs.*, **11** [8], 450 (1932). G.R.S.

Refractory materials for regenerators. II. ALFRED B. SEARLE. *Blast Fur. Steel Plant*, **20** [11], 857–58 (1932).—Subject to variations which are called for by local conditions, the following kinds of brick are desirable in a regenerator: (1) for the foundation walls, silica brick of uniform size, laid with the thinnest possible joints; (2) for the side walls, close-grained fireclay brick, preferably with ample grog in their composition, should be used; (3) the roofs may be built of fireclay brick or silica brick, the former being preferable as they can better withstand the sudden changes in temperature; (4) the checkerwork or filling should be mainly of fireclay brick; (5) the flues connecting the regenerator with the furnace should be lined with fireclay brick, but these may be backed by silica brick, if desired. For Part I see *Ceram. Abs.*, **12** [1], 22 (1933). E.J.V.

Refractory compositions for lining steel ladles. ANON. *Foundry*, **60** [1], 50–51 (1932). F.G.H.

Pulverized fuel and some refractory problems. ANON. *Fuel Econ.*, **8** [86], 111–14 (1932).—This paper describes the failure of several kinds of refractories in tangentially fired powdered coal furnaces capable of liberating 80,000 B.t.u./cu. ft./hr. Illustrated. W.E.R.

Raw materials for silica brick manufacture. II. N. H. STOLTE. *Ceram. Age*, **20** [1], 19–20 (1932).—S. concludes his discussion of sources and compositions of quartzites. For Part I see *Ceram. Abs.*, **11** [11], 573 (1932). R.G.M.

Graphite in France. C. V. *Ind. chimique*, **19** [221], 406–407 (1932).—A short description of graphite deposits in France, and the mining and uses of graphite are given. M.V.K.

Russian magnesite. J. REWSIN. *Stroitel. Material.* [Moscow], No. 1, pp. 98–117 (1932); abstracted in *Feuerfest*, **8** [10], 149–50 (1932).—R. describes (1) different magnesite deposits found in the Urals and Siberia, (2) their economic significance, (3) Russian magnesite industry, and (4) Russian magnesite in Europe. M.V.K.

Magnesite in India. FRED LEBETER. *Iron Coal Trades Rev.*, **125** [3375], 689–90 (1932).—The geological formation, method of working, mining operations, uses of crude magnesite, uses of lightly calcined magnesite, and the conditions of labor at the deposits of magnesite in India are described. The uses of crude magnesite are limited; it is used in the manufacture of Epsom salts. Calcined Indian magnesite is used for thermal insulation, cement, woodstone flooring, and binder for coal briquets. Because of the purity of Indian magnesite little dead-burning is done. When it is done, iron oxide must be added. Illustrated. W.E.R.

Trade names in the fields of refractory materials. ANON. *Feuerfest*, **7** [9], 136–41 (1931); abstracted in *Metals & Alloys*, **3** [10], 313 (1932).—Trade names of all kinds of materials connected with furnace construction and the refractory industry of German and international origin are compiled and briefly characterized. E.P.R.

BOOK

Magnesite and Its Preparation. (Magnesit und seine Verarbeitung.) R. BAUER. Theodor Steinkopff, Dresden and Leipzig, 1932. Price 5.80 M. *Z. Ver. deut. Ing.*, **76** [46], 1136 (1932).—The preparation of magnesite, especially sinter magnesite, and its use as a refractory are described. A bibliography is included. L.T.B.

PATENTS

Process for producing aluminum chloride. W. H. SHIFFLER AND W. P. ANDERSON (Standard Oil Co. of California). U. S. 1,887,566, Nov. 15, 1932.

Filling block for heat exchange, reaction, and absorption apparatus. HUGO WILISCH. U. S. 1,887,704, Nov. 15, 1932.

Production of aluminum hydroxide. S. S. SVENDSEN (Clay Reduction Corp.). U. S. 1,889,080, Nov. 29, 1932.

Process of producing silica brick, etc. M. HOLLENWEGER. Brit. 382,913, Nov. 9, 1932.

Process for manufacturing hard objects of carbon silicide, etc. A-L. MINGARD. Brit. 383,540, Nov. 23, 1932.

Terra Cotta

Methods of engobing. ANON. *Tonind.-Ztg.*, **56** [89], 1097 (1932).—Engobing may be done immediately after pressing or drying the products. A simple mechanical device is shown using a conveyer which has metal sheets of various forms in which the products can be placed. The conveyer carries the products through the engobe tank and stirs the engobe constantly. See also article by Spitta, *Ceram. Abs.*, **12** [1], 25 (1933). W.M.C.

Sculpture and industry: faience reliefs on a new industrial building. ANON. *London Studio*, **103**, 152–54 (1932).—Designed by Frank Dobson and executed by Doulton's, a series of reliefs in faience, gilt over the glaze, have been set in black upon the Portland stone façade of the new Hay's Wharf building on the Thames River. The figures represent industry, capital, and labor with crown emblems of barrels, drums, crates, chains, etc. The reliefs suggest the enormous possibilities of sculpture today. H.H.S.

PATENT

Flower and plant pots and their manufacture. H. A. MILFORD. Brit. 383,241, Nov. 16, 1932.

White Wares

Control of the proper composition of porcelain and whiteware batches and glazes. I. S. PULIESO. *Sprechsaal*, **65** [46], 823–25 (1932).—The determination of the specific weight of the batch as a means of control and its significance are described. II. *Ibid.*, **65** [47], 837–39 (1932).—The determination of the loss of weight on ignition and the determination of CO_2 in batches containing carbonates are described as additional control methods. W.W.B.

Use of Weiherhammer white pegmatite in technical porcelain bodies. OTTO KRAUSE. *Sprechsaal*, **65** [45], 807–808 (1932).—The suitability of Weiherhammer pegmatite as a substitute for costlier raw materials in technical porcelain bodies is shown. In tests made by K., there was a considerable increase in the mechanical strength in the porcelain made with pegmatite over that made in the usual manner. See also article by Rieke and Mauve, *Ceram. Abs.*, **6** [12], 612 (1927). W.W.B.

Experiments with bone china bodies. OTTO KRAUSE AND LOTHAR SCHLEGELMILCH. *Ber. deut. keram. Ges.*, **13** [10], 437–53 (1932).—Tests for the determination of sintering behavior and the chemical, mechanical, and structural properties of bone china bodies were conducted, on the basis of which the firing behavior and the structure of the bodies were characterized and conclusions with respect to the technical properties of bone china were drawn. E.J.V.

Ceramic material of low thermal expansivity. ANON. *Jour. Franklin Inst.*, **213**, 89 (1932); *Refrac. Jour.*, **8** [9], 360 (1932); for abstract see article by Geller and Insley, *Ceram. Abs.*, **11** [10], 542 (1932). J.T.L.

BOOKS

Theory of Dielectrics. A. SCHWAIGER. Translated by R. W. Sorenson. John Wiley & Sons, New York, N. Y. 480 pp. Price $6.50. *Mining & Met.*, **13** [312], 3 (1932).—This is a comprehensive, readily understandable presentation of the laws of

dielectrics divided into three parts, *i.e.*, puncture, arc-over, and the practical applications of high-voltage engineering. E.J.V.

Porcelain As an Art and a Mirror of Fashion. ROBERT SCHMIDT. George G. Harrap & Co., London. Price 25s net. *Pottery Gaz.*, **57** [666], 1520–21 (1932).—S. seeks to accord to porcelain a rightful place in connection with European art and society, dealing with it not merely as a material for collectors but as a medium with its own technical qualities. The historical trend and changes in fashion of porcelain from the early Chinese period are indicated. Oriental porcelain, Meissen and other German porcelain, French, Italian, and English porcelains are separately dealt with. E.J.V.

PATENTS

Noninterfering insulator. K. A. HAWLEY (Locke Insulator Corp.). U. S. 1,889,244, Nov. 29, 1932.

Coffee maker. ADOLF COORS (Coors Porcelain Co.). U. S. 1,889,543, Nov. 29, 1932.

Glaze for earthenware dishes. H. J. MCMASTER. U. S. 1,890,297, Dec. 6, 1932. In the manufacture of yellow glaze dishes of uniform color intensity, the steps comprise calcining sodium uranate with china clay and flint, adding the calcined mass to a transparent white glaze composition in such proportion that the quantity of uranium salt in the resulting mixture shall be approximately between 1 and 3% of the total mass, dipping an unglazed dish into the mixture, and thereafter firing the ware in a nonreducing atmosphere.

Equipment and Apparatus

Flowmeters. LOUIS GESS. *Heating, Piping, Air Conditioning*, **4** [12], 792–93 (1932).—Flowmeters for measuring amounts of steam, gas, oil, water, and other fluids are given. Measurements of flow of steam, liquids, and gas are considered. Illustrated by diagrams. J.L.G.

Continuous carbon monoxide indicator. MINE SAFETY APPLIANCES CO. *Jour. Sci. Instruments*, **9** [10], 327–28 (1932).—The instrument is described with the aid of a diagram. J.L.G.

Heat-resisting metals in the pottery industry. J. FERDINAND KAYSER. *Pottery Gaz.*, **57** [666], 1493–94 (1932).—To meet the variable needs in the pottery industry a number of different heat-resisting alloys have been developed, each having its own special characteristics. The most essential characteristic was surface stability at high temperatures, which was comparatively easy to attain. Various uses of heat-resisting alloys in the vitreous enameling industry, the pottery industry, the glass industry, and in metal recuperators are listed. E.J.V.

Austenitic alloy irons and their applications in the glass industry. G. S. BELL. *Glass*, **9** [11], 474–77 (1932).—Austenitic alloy cast iron contains 25% nickel and possesses entirely different properties from all ordinary cast irons. It has remarkable resistance to the effects of heat. Changes are discussed which take place when ordinary cast iron is heated. The changes in the iron produced by the additions of chromium are described. Results of tests are given to explain why the alloy is finding such rapidly increasing applications in the glass industry. G.R.S.

Design, application, and cost of standardized drives for overhead chain conveyers. G. A. HOLMES. *Maintenance Eng.*, **90** [11], 409–12 (1932).—Standardized construction in drives for overhead chain conveyers needs few repair parts and facilitates the task of relocating equipment when the plant layout is altered. The conveyers considered are (1) long conveyers, 750 to 4000 ft., heavily loaded, and (2) short conveyers, 50 to 75 ft., lightly loaded, requiring 1-h.p. motors. These classes are subdivided into conveyers which operate at a constant speed and those which operate at variable speeds to meet changing operating conditions. A further division is made in the type of drive, either sprocket or caterpillar. Illustrated with drawings and a cost-capacity chart. J.L.G.

Pump for large volumes. DE LAVAL STEAM TURBINE CO. *Heating, Piping, Air Conditioning*, **4** [10], 683–85 (1932).—A propeller pump for handling large volumes of liquid against comparatively low heads is described. It is made in all capacities and for heads up to about 40 ft. Illustrated. J.L.G.

Two auxiliary apparatus for the petrographic microscope. I. Microscope refractome-

ter after Lindley. K. H. SCHEUMANN. *Mineralog. petrog. Mitt.*, **41** [1], 58–63 (1931).—A refractometer is described which is fitted with a prism of the glass usually employed, and the whole is mounted on a petrographic microscope. The instrument permits the immersion of mineral grains in a liquid as well as the measurement of the refractive index of the liquid. A range of $N = 1$ to $N = 5$ is possible. G.R.S.

Micropyrometers. G. LEWIN. *Z. tech. Physik*, **13** [10], 497–98 (1932).—The principles underlying the building of micropyrometers are outlined. The magnification can be increased by using eyepieces with a special set of lenses. W.M.C.

Illumination of surfaces for macro- and micro-photographic pictures. F. HAUSER. *Glastech. Ber.*, **9** [3], 139–44 (1931).—Devices used for taking macro- and micro-pictures are described. M.V.K.

Precision measurements of small changes in length. R. MOHR. *Z. tech. Physik*, **13** [10], 477–79 (1932).—For measuring changes in length, *e.g.*, thermal expansion, a piston connected with the expanding body acts on a liquid contained in a closed cylinder. A capillary tube is connected to the cylinder. If the body expands by a small amount the liquid will move in the capillary and allow, after calibration, the measuring of the expansion. Small pressure changes may be measured by the same method. W.M.C.

Slide rule for ceramists. H. KLAUS AND W. MIEHR. *Keram. Rund.*, **40** [9], 111–15 (1932). H.I.

Revolving furnaces. ZOLLINGER. *Zement*, **21** [41], 578–80; [42], 591–93 (1932).—The latest improvements on revolving furnaces in Germany are discussed. M.V.K.

Mold-making machinery. F. S. HARMER. *Pottery Gaz.*, **57** [666], 1496 (1932).—A variety of machines specially designed and erected for the use of glass manufacturers includes a horizontal milling machine, such as is used for milling the flat faces of glass-working molds, a special capstan lathe for the machining of neck-ring molds, a combination turret lathe used for the production of standard bottle molds, and two machines of particular interest, the "Keller" automatic bottle mold machine and the "Monarch Keller" automatic form-turning lathe. E.J.V.

Dies. ANON. *Tonind.-Ztg.*, **56** [88], 1086–87 (1932).—Dies which are not being watered may be divided into dies for solid brick and for hollow ware. Possibilities are discussed of improving a die if it is not working satisfactorily. Illustrated. W.M.C.

High-capacity drier. ANON. *Chem. Met. Eng.*, **39** [11], 625 (1932).—The new drier has been used satisfactorily in the drying of lumps of filter cake as discharged from continuous filters. A drawing illustrates the design of the drier. G.R.S.

Opportunities for using indicating and recording control instruments in the rock products industries. II. Instrumentation in tunnel kilns. JAMES R. WITHROW. *Rock Prod.*, **35** [22], 20–23 (1932).—W. discusses drying of clayware, drying control instruments, firing, and firing control methods. Tunnel kilns, their advantages, and temperature control instrument installations are discussed. For Part I see *Ceram. Abs.*, **11** [10], 537 (1932). W.W.M.

Relationship of theory and experience in industrial drying and processing. VII. Industrial oven design, construction, and operation. C. F. MAYER. *Fuels & Fur.*, **10** [9], 599–601 (1932).—A discussion of factors affecting the fuel consumption of industrial ovens, and data on thermal efficiencies from average practice are given. For Part VI see *Ceram. Abs.*, **11** [12], 630 (1932). E.J.V.

Artificial drying of raw refractories for glassmelting furnaces. M. KAZANSKII AND P. YAGUPOV. *Keram. i Steklo*, **8** [7], 23 (1932).—A discussion is given of (1) conditions of drying of raw refractory products, (2) experiments with drying at the Lenzos works, (3) accelerated drying in installations with multiple feeding, and (4) adaptability of such driers for drying refractory products. M.V.K.

Crushers and grinders. ANON. *Corriere ceram.*, **13** [8], 291–93 (1932).—The size of the pieces and the physical properties of the rock determine whether a jaw or movable crusher should be used. The use of the cylinder grinder is not extensive but practice shows it is more advantageous for the final grinding than the regular millstone grinder. M.V.K.

Grinding plant research. VIII. Tests on standard sand in experimental mill with smooth lining plates. WILLIAM GILBERT. *Rock Prod.*, **35** [20], 23–25 (1932).—G. describes grinding experiments using as grinding media two sizes of steel balls, cylpebs, and three sizes of flint pebbles in a mill with smooth lining plates. Results are shown by graphs giving relation between speed factor and output and between speed factor and horse power. The effect of partial charges of the various grinding media was also studied. One-inch steel balls were apparently found to be the most efficient grinding media when mill speed, charge weight, and material-to-void ratio were suitable. For Part VII see *Ceram. Abs.*, **11** [11], 583 (1932). W.W.M.

Milling conditions in small ball mills. H. KRUG AND K. SCHWANDT. *Keram. Rund.*, **40** [8], 93–96; [10], 126–31 (1932).—The effect of number of balls, ball size, quantity of water, quantity of material, grain size of the materials, and rotation rate on the efficiency of a small porcelain ball mill using hard porcelain balls was studied. In general, mill efficiency increased with (1) the number of balls, (2) the size of the balls, and (3) increasing rotation rate up to a maximum; it decreased directly with increase in quantity of material in the mill. The influence of the amount of water added is relatively small. H.I.

Contribution to the study of viscous friction and application to the theory of lubrication. P. MERCIER. *Jour. Rheol.*, **3** [4], 391–412 (1932).—Origins and relations of the idea of the dynamic film to the classic results concerning viscosity are treated. M. shows a simple and new form for the component of the viscous force due to the velocity with its new notations. A discussion is given of (1) experimental study of simple slip, (2) influence of proximity of walls, (3) inadequacy of the classical expressions concerning the forces due to convergence or divergence, (4) plane films with forced uniform motion, (5) zone of crushing, (6) the two zones of viscous accelerations, and (7) the surface of zero velocity. G.R.S.

Testing lubricants. ANON. *Tonind.-Ztg.*, **56** [85], 1056–57 (1932).—A review of different standard tests for lubricants is given. Illustrated. W.M.C.

Measurement of stress by bending laminated ceramic products. W. SIEGER. *Keram. Rund.*, **40** [3], 29–33 (1932).—The test piece consists of a lath-shaped piece, somewhat thicker at the ends than in the middle, which contains two or more layers such as a glazed whiteware body. A controllable furnace surrounds the piece axially leaving the two ends protruding. One end is firmly fastened while the other is free to move. A telescope and scale measure the movement of the free end caused by stresses during heating or cooling of the specimen. Curves relating temperature and bending are given for glazed whiteware, enameled cast iron, surface-sintered refractory body, and a refractory body with coal ash fused on one surface. See also *Ceram. Abs.*, **11** [4], 253 (1932). H.I.

Testing glazed ceramic products under steam pressure. ANON. *Keram. Rund.*, **40** [17], 215–17; [18], 229–30 (1932).—A review is presented of papers by Schurecht (*Ceram. Abs.*, **7** [12], 844 (1928)), Wright (*ibid.*, **8** [4], 280 (1929)), Schurecht and Pole (*ibid.*, **8** [11], 822 (1929); **10** [8], 580 (1931)), Mills (*ibid.*, **10** [1], 48 (1931)), and Holscher (*ibid.*, **10** [4], 280 (1931)). H.I.

Status of possibilities of diascopic X-ray tests. H. REININGER. *Werkstattstechnik*, **25** [5], 225–30 (1931); abstracted in *Metals & Alloys*, **3** [9], 266 (1932).—The principle of translucency for X-ray is discussed and apparatus for this simplest method of X-ray testing in the shop is described. A list of 30 references is added. E.P.R.

Rapid method for determination of moisture in flour and other finely-divided materials. E. A. FISHER AND J. THOMLINSON. *Jour. Soc. Chem. Ind.*, **51** [42], 355–58 (1932).—An apparatus for the rapid determination of moisture in finely powdered materials is described. The material is mixed with calcium carbide and the loss of weight due to loss of acetylene (produced by interaction of the carbide and the moisture present) is determined. The method is rapid (20 min.) and is subject to smaller errors than are the more usual oven methods of moisture determination. Its limitations are discussed. G.R.S.

Analysis of dispersions of mixtures according to Schulze and Harkort. H. HARKORT. *Tonind.-Ztg.*, **56** [83], 1031–33 (1932).—Details are given for the analysis of dispersions by means of several methods. The apparatus developed by Schulze and Harkort has the advantage that the velocity of elutriation can be regulated accurately. The velocities range from 0.008 to 3.190 mm./sec. Particles of size between 3 and 200μ can be distinguished. This analysis is used for controlling the raw materials, ground products, and products not only of the ceramic industry but also of the chemical industry. W.M.C.

Physical processes of the so-called electrical purification of gases. II. Maximum charge of suspended particles. R. LADENBURG AND H. SACHSSE. *Ann. Physik*, [5] **4** [7], 863–97 (1930). **III.** R. LADENBURG. *Ibid.*, **14** [5], 510–20 (1932).—Suspended particles of more than 10^{-4} cm. size will pick up a radial velocity through their charge and the electric field of the corona discharge. The charge is proportional to the size of the particles. Smaller particles will gain only velocities of from $^1/_2$ to $1^1/_2$ in./sec., but technically they play only a minor part. The electric wind originating from the glow discharges will give the particles an additional velocity of from 8 to 24 in./sec. The axial streaming of the gas, however, will diminish the action of the electric wind. For Part I see *Ceram. Abs.*, **10** [10], 734 (1931). W.M.C.

Structural properties of anisotropic solutions of soap as determined by a new centrifugal falling ball method. J. W. McBAIN AND O. O. WATTS. *Jour. Rheol.*, **3** [4], 437–60 (1932).—A centrifugal ball plastometer was devised. The results obtained with it were so much more instructive than those with the extrusion plastometer that this method may become an indispensable tool in the study of plastic materials. Its construction and operation are so simple that it is available for routine use. G.R.S.

Calorimetric method for determining the intrinsic energy of a gas as a function of the pressure. EDWARD W. WASHBURN. Bur. Stand. *Jour. Research*, **9** [4], 521–28 (1932); R.P. 487. R.A.H.

Eliminating oil and water from compressed air lines. J. E. SWENDEMAN. *Ind. Finishing Mag.*, **9** [1], 9–13 (1932).—Although the plan of the separator is not shown, sketches are given showing the installation of the separator in different types of lines. J.L.G.

Synchronized mechanical motion without mechanical connection. C. W. DRAKE. *Maintenance Eng.*, **90** [12], 441–43 (1932).—Synchronized mechanical motion by means of synchronized electric motors is described. In such a system electric wiring replaces line shafting, belts, and clutches. Identical wound-rotor induction motors are used with their primary windings connected to the a.-c. supply and their rotor windings connected together. Two machines thus powered are always revolving at exactly the same speed and in synchronism and there will be no change in the angular position of the two rotors with respect to each other for a given load. Illustrated by diagrams and photographs. J.L.G.

Cost-cutting motor maintenance. MARIN PHILLIPS. *Maintenance Eng.*, **90** [11], 412–14 (1932).—Motor maintenance has to contend with failures due to overloads, moisture in windings, bearing troubles, and oily windings. Causes and cures for these troubles are discussed. J.L.G.

Calculating pipe sizes and pressure drops. G. A. GAFFERT. *Power Plant Eng.*, **36** [18], 708 (1932).—A nomographic chart assists in determining velocities and pressure drops for saturated and superheated steam without reference to tables. E.P.R.

Wear of metal in muller tires in the clay industry. J. MAYER. *Brick Clay Rec.*, **81** [5], 168 (1932).—A report of tests of chrome-molybdenum alloy steel casting reveals longer performance qualities. E.J.V.

Kilns, Furnaces, Fuels, and Combustion

Firing aids for muffle kilns in ceramic plants. E. MOTSCHMANN. *Keram. Rund.*, **40** [25], 318–21 (1932).—Arrangements of kiln settings and types of supports for ware in the kiln are described. H.I.

Kilns for producing sintered magnesite. ANON. *Tonind.-Ztg.*, **56** [90], 1109–1110 (1932).—Rotary or shaft kilns may be used for manufacturing sintered magnesite. W.M.C.

Wall construction of continuous kilns. ANON. *Corriere ceram.*, **13** [8], 295–97 (1932).—Defects in the construction of the inside masonry of continuous kilns are considered. M.V.K.

Firing difficulties with the ring kiln. ANON. *Tonind.-Ztg.*, **56** [85], 1052–53 (1932). W.M.C.

Protective coatings for the ring kiln. ANON. *Tonind.-Ztg.*, **56** [90], 1111 (1932). W.M.C.

Eight periodic kilns to equal one zigzag kiln. L. SCHIELE. *Tonind.-Ztg.*, **56** [83], 1033–34 (1932).—Eight periodic kilns were combined to form one kiln operating continuously by adding the necessary channels and connections. Illustrated. W.M.C.

Electric kiln made from fluorite. A. DAMIENS AND L. DOMANGE. *Compt. rend.*, **192** [26], 1711–13 (1931); *Chim. & ind.*, **26** [6], 1352 (1931); *Sprechsaal*, **65** [4], 66 (1932).—By means of a porcelain-like mass made from fluorite, an electric tube kiln for temperatures over 1000° was constructed. The mass was fired to 1300° to make the heating and reaction tube gas-tight. The heating element was covered with a fluorite paste. The heating tube was inserted in an iron tube and the space between the tubes was filled with fluorite powder. This kiln is designed for working with fluorine and its gaseous compounds at high temperatures. M.V.K.

Present electric furnaces for firing glass and porcelain painting. B. ALLERT. *Glashütte*, **62** [35], 612–14 (1932).—A. discusses the development of electric furnaces

utilized for firing paintings and decorations on glass, porcelain, and whiteware. The latest types of such furnaces together with operating data from practice are described. M.V.K.

Heat balances of industrial furnaces and their practical application. W. A. Moorshead. *Power Fuel Bull.*, **19**, 103 (1932); for abstract see *Ceram. Abs.*, **11** [11], 587 (1932). W.E.R.

Influence of metallurgical developments on furnace practice. Anon. *Metallurgia*, **6** [36], 177–78 (1932).—The development of the mechanical furnace is largely dependent on the application of materials capable of combining refractory, structural, and workable properties to build a furnace to operate at the desired temperature. Materials available, design and workmanship, the firing of ceramic ware, vitreous enameling, and recuperators are discussed. M.V.K.

Problems of the coke-oven industry. G. E. Foxwell. *Gas Eng.*, **49** [11], 537–38 (1932). J.L.G.

Fuels, solid, liquid, and gaseous. N. H. Humphrys. *Power Fuel Bull.*, **21**, 136 (1932); for abstract see *Ceram. Abs.*, **11** [12], 629 (1932). W.E.R.

Classification of coal. Anon. *Rev. universelle mines*, **75**, pp. 191–97 (Feb., 1932); abstracted in *Feuerungstechnik*, **20** [9], 139 (1932).—The industrial classification of coal in Belgium, including that used for glassworks and ceramic furnaces, is given. M.V.K.

Properties of coal which affect its use in the ceramic industry. W. E. Rice. *Clay Prod. News*, **5** [9], 4; [10], 4–5 (1932); for abstract see *Ceram. Abs.*, **11** [5], 319 (1932). W.W.M.

Coal nomenclature: the buyer's dilemma. H. C. Armstrong. *Fuel Econ.*, **8** [85], 67–68 (1932); abstracted in *Power Fuel Bull.*, **22**, 141 (1932).—This article reviews the confusion existing in the classification of coals of different sizes and descriptions and the economic and commercial necessity of standardizing efficiently the coals marketed. W.E.R.

Effect of oxidation on the coking properties of coal. R. V. Wheeler and F. G. Woolhouse. *Fuel Sci. Prac.*, **11** [2], 44–55 (1932); abstracted in *Metals & Alloys*, **3** [10], 312 (1932). R.G.M.

Chemistry and technology of solid fuels. Camille Matignon. *Chim. & ind.*, **28** [5], 1018–24 (1932).—The results of researches on the constituents of coal and their interrelation and different theories on the formation of brown coal and pyrogenous distillation are reviewed. M.V.K.

Pulverized coal: significance of its analysis to the consumer. Rapier R. Coghlan. *Rock Prod.*, **35** [23], 20–22 (1932).—C. shows how to calculate, from the proximate analysis and the ultimate analysis of a coal, the combustible elements present and the amount of air required for combustion of a unit weight of the coal. The proper amount of primary air in combustion may mean a saving of thousands of dollars in a million dollar annual fuel bill. Tabular data on coals are given. W.W.M.

Pulverized fuel for the small unit-shell type boiler, metallurgical and chemical processes. H. W. Hollands and E. C. Lowndes. *Trans. World Power Conf.* [Tokyo Sectional Meeting], **3**, 771–85 (1931); abstracted in *Metals & Alloys*, **3** [9], 280 (1932).—The design of a combustion chamber to convert pulverized coal into producer gas is briefly described. It is small, temperatures are low (resulting in low upkeep), and ash is not carried into the tubes. Combustion of the producer gas is effected in the boiler tubes or on the working hearth (metallurgical furnaces), giving the highest temperature at the point of use. Advantages of pulverized coal in puddling furnaces, steel ingot heating furnaces, forge furnaces, etc., are described. E.P.R.

Combination burning of blast-furnace gas and pulverized fuel. Otto de Lorenzi. *Combustion*, **3** [3], 36–40 (1932); abstracted in *Metals & Alloys*, **3** [9], 280 (1932).—Test data on a steam-generating unit fired by blast-furnace gas and pulverized coal in combination are given. Calculations are described for obtaining coal-gas weight ratios. Control systems and recent developments in furnace design and methods of firing are given for plants using these two fuels in combination. See also *Ceram. Abs.*, **9** [2], 126 (1930). E.P.R.

Utilizing hot or cold gas in the glass and enamel industries. A. Jaeschke. *Glashütte*, **62** [33], 561–63 (1932).—By cold gas is meant gas obtained in generators and purified by different apparatus on its way to the place of combustion; hot gas is understood to be a generator gas containing its heat, tar constituents, and moisture. The use of hot gas is desirable from the heat-technical standpoint, although in some cases cold gas is more advantageous. Pressure gas heating, introduced in the glass and enamel industries, has shown considerable advantages over low-pressure heating. The gas pres-

sure produces a uniform gas-air mixture; the pressure gas burners work generally without preheating, and the excess pressure also prevents the penetration of cold air into the furnace. Generator gas must be purified and cooled to be used successfully in pressure gas burners. The use of cold gas for pressure gas heating in the glass and enamel industries has been successful and practice shows that a cooled and purified gas has more value than an unpurified gas of the same chemical composition. Different methods for purifying generator gas used in Germany are discussed. M.V.K.

Cleaning blast-furnace gas. GUY BARRETT. *Iron & Steel Ind.*, **5** [12], 129–39 (1931); abstracted in *Metals & Alloys*, **3** [9], 280 (1932).—A résumé of the knowledge of wet washing, electrostatic deposition, and filtering methods for cleaning blast-furnace gases is given. E.P.R.

Oil fuel for pottery firing. I. LUBBOCK. *Pottery Gaz.*, **57** [664], 1253–54 (1932).—After briefly summarizing the advantages of oil as a fuel, L. gives some details in relation to types of burners used in oil firing. Various types of fire mouths or combustion chambers that have been successfully applied are discussed. The absolute necessity of using the highest quality refractory for each portion of the combustion chamber construction is emphasized. Some successful applications are enumerated. E.J.V.

Fuel in the refractory industry. ALAN STEIN. *Fuel Econ.*, **8** [86], 96 (1932).—This article was abstracted from the Presidential address to the English Ceramic Society. W.E.R.

Town's gas as fuel for pottery firing. ANON. *Gas World* [Ind. Gas Supp.], **97**, 86–87 (1932); abstracted in *Power Fuel Bull.*, **21**, 126 (1932). W.E.R.

Tendency to increased fuel economy in the ceramic industries. S. R. HIND. *Power Fuel Bull.*, **19**, 98 (1932); see also *Ceram. Abs.*, **11** [11], 588 (1932). W.E.R.

Diffusion of flame combustion. H. C. WELLER. *Heat Treating Forging*, **18** [11], 649–51 (1932).—The principles involved in flame combustion and its diffusion are considered. Illustrated. J.L.G.

Mechanism of combustion of individual particles of solid fuels. D. F. SMITH AND A. GUDMUNDSEN. *Fuel Sci. Prac.*, **11** [4], 124–34 (1932); see also *Ceram. Abs.*, **10** [11], 801 (1931). R.G.M.

Effect of ash on reactivity and combustibility of carbon materials. YOCHIKIYO OSHIMA AND YOSHITAMI FUKUDA. *Fuel Sci. Prac.*, **11** [4], 135–51 (1932). R.G.M.

Mechanism of the combustion of fuel in industrial furnaces. M. W. TRAVERS. *Jour. Inst. Fuel*, **6** [25], 45–48 (1932); abstracted in *Power Fuel Bull.*, **22**, 151 (1932). W.E.R.

Heat content-temperature diagram of incomplete combustion. P. ROSIN AND R FEHLING. *Z. Ver. deut. Ing.*, **75** [30], 959–63 (1931).—In an earlier publication the heat content-temperature diagram was developed, by means of which the fuel requirements of a furnace may be calculated readily. The work reported here is a further development for the technically important region of incomplete burning. Incomplete burning is often employed in chemical and ceramic furnaces to produce a reducing atmosphere. The relations between air requirements, flue-gas volumes, heat content, and heating values are discussed for these conditions of incomplete combustion. L.T.B.

Firing ceramic ware. G. MILANI. *Corriere ceram.*, **13** [1], 15–19; [2], 63–67 (1932).—With incomplete combustion of the gas in the firing chamber or in a reducing atmosphere, carbon is often deposited on ceramic ware and damages ware containing much clay, kaolin, or colloidal material in general. The CO and the hydrocarbons of the gas (CH_4 and C_2H_4) are most active between 400 and 800°C. CO is the least injurious and above 1000°C acts as an excellent reducing agent. To prevent the deposit of carbon in the ware, carbonic anhydride is completely effective when 2 volumes are mixed with 1 volume of gas (C_2H_4) at 1100 to 1200°C. If the carbon deposited on the ware is oxidized too rapidly, blisters or granulation of the surface often results. See also *Ceram. Abs.*, **11** [11], 587 (1932). M.V.K.

Rational use of saggers. F. M. LOPUKHA. *Keram. i Steklo*, **8** [7], 11–13 (1932).—L. discusses (1) the influence of the dimensions of the sagger on its efficiency, and (2) the conditions for a rational arrangement of the ware in saggers. A detailed calculation has been worked out with regard to the increase of the output and economy in fuel and raw materials with the use of well fitting saggers. M.V.K.

Estimation of ash content of coals by tint measurements. W. GROSS AND C. ABRAMSKY. *Fuel Sci. Prac.*, **11** [4], 154–58 (1932); for abstract see *ceram. Abs.*, **10** [12], 857 (1931). R.G.M.

Elimination of sulfur compounds from boiler-furnace gases. H. F. JOHNSTONE. *Fuel Sci. Prac.*, **11** [3], 84–90 (1932); for abstract see *Ceram. Abs.*, **11** [11], 588 (1932). R.G.M.

Microscopical appearance of flue dusts. A. ECCLES AND A. MCCULLOCH. *Fuel Sci. Prac.*, **11** [3], 102–13 (1932). R.G.M.

Natural graphite for electrodes. I. S. KAJDANE AND I. I. KOLESNIKOV. *Mineral. Suir'e*, **6** [10–11], 1037–46 (1931); abstracted in *Chim. & ind.*, **28** [4], 865 (1932).—The most important factor for this method is the nature of the bonding agents used. Experiments are described. Electrodes composed of coke (30 parts), graphite (70 parts), and coal tar (bonding agent) pressed together and fired in a Mannheim furnace were found to be satisfactory. The true and apparent densities and porosity of the electrodes are similar to those of the electrodes manufactured from artificial graphite in France, Germany, and the U. S. The electrical resistance of electrodes made of natural graphite, however, was found to be far superior to electrodes made of artificial graphite. M.V.K.

Improvement of the heat exchange in recuperative air preheaters. HARRAEUS. *Feuerungstechnik*, **20** [10], 149–52 (1932).—Different methods influencing heat transfer through conduction, convection, radiation, and the inner conduction of heat are considered. M.V.K.

Continuous gas indicator. ANON. *Chem. & Ind.*, **51** [39], 796–97 (1932); *Power Fuel Bull.*, **21**, 136 (1932).—The apparatus provides a continuous indication of the amount of one gas contained in another, *i.e.*, hydrogen in air or nitrogen in oxygen. A diagram and explanation of the operation of the apparatus are given. G.R.S.

Slide rule simplifies gas calculations. P. F. MARX. *Chem. Met. Eng.*, **39** [10], 556–57 (1932).—By the use of the slide rule most gas problems may be worked without the use of tables. The basis of the rule is the relation of molecular weight to the weight of a gas in pounds per cubic foot which, with the laws of Boyle and Charles, gives all the data necessary to construct the scales. Directions are given for the construction and use of the slide rule. G.R.S.

Measuring the temperature of flowing gases in furnace system. Comparison between the ordinary thermocouple and suction pyrometers. M. PARKIN AND F. WINKS. *Jour. Soc. Glass Tech.*, **16** [63], 315–26 (1932); for abstract see *Ceram. Abs.*, **10** [9], 651 (1931). G.R.S.

Nomographs of the calculation of air and gas velocity. A. ALISON. *Chem. Met. Eng.*, **39** [11], 623–24 (1932).—The method described requires the measurement of the velocity head in inches, using a Pitot tube, together with the measurement of the temperature of the gas in degrees F and its specific gravity relative to air, if gas other than air is to be measured. G.R.S.

Thermal insulation and heat insulation in industrial chemistry. AM. MATAGRIN. *Rev. chim. ind.*, **41** [486], 171–76; [487], 199–205; [488], 225–32 (1932).—M. discusses (1) the general principles of thermal insulation, (2) diatomite or kieselguhr, (3) carbonated magnesia, (4) fibrous silicates, mineral wool, and asbestos, (5) natural silk, and (6) glass wool. M.V.K.

Coal-conveying plant of the new electricity works at Montevideo. ANON. *Eng. Prog.*, **13** [10], 221–22 (1932).—The plant is situated at the water's edge. The coal-conveying system includes a grab crane which takes the coal directly from vessels and deposits it on a belt conveyer in which there is an automatic weighing device. Illustrated. J.L.G.

BOOKS AND BULLETINS

Electric Furnaces and Ovens for Heating and Annealing. (Elektrische Industrie Öfen für Weiterverarbeitung.) V. PASCHKIS. 290 pp. 231 illustrations. 31.5 M. Julius Springer. *Fuels & Fur.*, **10** [9], 602 (1932).—All types of electrically heated industrial furnaces and ovens are discussed and illustrated in detail. E.J.V.

Pulverized Fuel Firing. S. H. NORTH. I. Pitman & Sons, New York, 1932. $2.25. *Jour. West. Soc. Eng.*, **37** [5], 284 (1932); *Mech. World*, **91** [2370], 541 (1932); see also *Ceram. Abs.*, **11** [12], 642 (1932).

Combustion. AMERICAN GAS ASSN. 208 pp. $2.00. *Jour. West Soc. Eng.*, **37** [4], 227 (1932). W.W.M.

Calculation of Heat Transmission. MARGARET FISHENDEN AND O. A. SAUNDERS. 280 pp. Reviewed in *Trans. Faraday Soc.*, **28** [9], 779–80 (1932); see also *Ceram. Abs.*, **11** [11], 589 (1932). G.R.S.

Laboratory testing of inflammability of coal and other dusts. H. P. GREENWALD, with foreword by G. S. RICE. Bur. Mines *Bull.*, No. 365. 45 pp. Price 10¢ from Supt. of Documents, Govt. Printing Office, Washington, D. C. R.A.H.

Pneumatic tabling of coal; effect of specific gravity, size, and shape. H. F. YANCEY

AND C. B. PORTER. Bur. Mines *Tech. Paper*, No. 536. 18 pp. Price 5¢ from Supt. of Documents, Govt. Printing Office, Washington, D. C. R.A.H.

PATENTS

Continuous conveyer furnace. B. M. JOHNSON (Carborundum Co.). U. S. 1,887,904, Nov. 15, 1932.

Kiln car superstructure. H. E. FEAR (New Castle Refractories Co.). U. S. 1,890,978, Dec. 13, 1932.

Process of firing ceramic ware. W. PODMORE. Brit. 383,933, Nov. 30, 1932.

Muffle furnaces. GIBBONS BROS., LTD., AND T. E. BRIDGFORD. Brit. 383,949, Nov. 30, 1932.

Geology

Nonmetallic minerals and industry. W. M. GOODWIN. *Can. Mining Jour.*, **52** [27], 751–55 (1931).—At Shawinigan Falls, Quebec, where there is abundant cheap hydroelectric power, several minerals are treated by electrical power. Bauxite yields aluminum, and limestone and coke give calcium carbide which in turn gives acetic acid and other chemical products as well as carbon black. Sand, salt, and coke are used to obtain silicon carbide. G.M.H.

A geological chronometer. E. ANTEVS. *Can. Mining Jour.*, **51** [16], 388–90 (1930).—The origin of varved glacial clays and their value as horizon markers are discussed. Some examples are given of the way in which a study of varved clays enables the working out of an exact chronological history of ice sheets. See also abstract by S. A. Andersen, *Ceram. Abs.*, **11** [4], 265 (1932). G.M.H.

Chemico-genetic problems in kaolin and clay studies. DITTLER. *Angew. Chem.*, **45** [39], 620 (1932); for abstract see *Ceram. Abs.*, **11** [10], 540 (1932). L.T.B.

Physicochemical explanation of the genesis of granite. J. H. L. VOGT. *Z. deut. geol. Ges.*, **83**, 193–214 (1931).—A study is made of the system quartz–orthoclase–albite, and of crystallization in the series quartz-diorite–grano-diorite with quartz-monozite–alkali-lime-granite (with 68 to 72% SiO_2) –potash-soda-granite (with 75% SiO_2). V. concludes that the granitic magma first appears at the end of the magmatic differentiation. R.H.E.

Rôle of humus in weathering. FRITZ BEHREND. *Z. prakt. Geol.*, **39** [8], 113–18 (1931); abstracted in *Bull. Amer. Assn. Petroleum Geol.*, **16** [2], 219 (1932). G.M.H.

Discoloration of sediments by bacteria. QUENTIN D. SINGEWALD AND F. M. VAN TUYL. *Bull. Amer. Assn. Petroleum Geol.*, **14** [5], 626–28 (1930).—A black pigment, secreted as a result of metabolic processes of bacteria, produces a dark color in sediments which may explain the color of some dark muds and shales. G.M.H.

Hydrothermal synthesis of the calcium silicates. II. S. NAGAI. *Z. anorg. allgem. Chem.*, **207** [4], 321–39 (1932).—Hydrothermal experiments on mixtures of $CaCO_3$ and SiO_2 gave results similar to those on mixtures of CaO and SiO_2; at the lower temperatures less silicate is formed in the carbonate mixture than in the oxide mixture. In a mixture of the ratio, $CaO:SiO_2$, there is formed first of all $2CaO{\cdot}SiO_2$ and $3CaO{\cdot}2SiO_2$ which on longer heating tend to change to $CaO{\cdot}SiO_2$. Mixtures of ratios $3CaO:2SiO_2$ and $2CaO:SiO_2$ only form appreciable amounts of $CaO{\cdot}SiO_2$ at low temperatures; at 900° more basic silicates form readily. $CaO{\cdot}SiO_2$ is relatively difficult to decompose in 10% Na_2CO_3 solution compared to $2CaO{\cdot}SiO_2$ and $3CaO{\cdot}2SiO_2$. By the use of this solution a fractional separation of the silicates can be effected. This method was used to compare the relative amounts of the various silicates formed by hydrothermal synthesis with the amounts formed by dry synthesis. A study was made of the silicate hydrates. At low temperatures and pressures there are formed water-rich compounds of which $3CaO{\cdot}2SiO_2{\cdot}8H_2O$ is typical. At high temperatures and pressures the hydrates contain less water, *e.g.*, $3CaO{\cdot}2SiO_2{\cdot}H_2O$ and $CaO{\cdot}SiO_2{\cdot}(0.25H_2O)$. A comparison of these hydrated products with natural minerals shows that $3CaO{\cdot}2SiO_2{\cdot}8H_2O$ corresponds to afwillite, $CaO{\cdot}SiO_2{\cdot}(0.25H_2O)$ to xonothite, and $2CaO{\cdot}SiO_2{\cdot}H_2O$ to hillebrandite. The compound $3CaO{\cdot}2SiO_2{\cdot}H_2O$ has not been found naturally. For Part I see *Ceram. Abs.*, **11** [10], 515 (1932). L.T.B.

Magnetic susceptibility and magnetite content of sands and shales. D. M. COLLINGWOOD. *Bull. Amer. Assn. Petroleum Geol.*, **14** [9], 1187–90 (1930).—Using a magnetometer and energized solenoids, a definite increase in susceptibility with increase of magnetic mineral content was shown indicating that the susceptibility increases from shales through sandy shales and shaly sands to sands. G.M.H.

Origin of igneous rocks. ANON. *Nature*, **130** [3289], 745–46 (1932).—A detailed report is given of the discussion held in Section C (Geology) of the British Assn. at York in September. J.L.G.

Occurrence of iron oxides in nature. HERMAN HARRASSOWITZ. *Z. deut. geol. Ges.*, **83**, 491–502 (1931).—A review is presented. R.H.E.

McLure shale of the Coalinga region, Fresno and Kings counties, California. GERARD HENNY. *Bull. Amer. Assn. Petroleum Geol.*, **14** [4], 403–10 (1930).—The McLure shale is a name given to the brown shale of the southern Coalinga region previously termed Santa Margarita. Whether it is upper Miocene or lowest Pliocene is not known. A new name for the shale is imperative. G.M.H.

Studies in the mineral and chemical resources of the Mojave Desert. PARK L. TURRILL. *Jour. Chem. Ed.*, **9** [12], 2041–64 (1932).—Detailed interesting descriptions are given of inspection trips to, and resources of, the Mojave desert area comprising some 30,000 square miles of southeastern Calif. and southern Nev. See also *Ceram. Abs.*, **11** [12], 634 (1932). A.K.

Shales and brick clays of Georgia. RICHARD W. SMITH. *Jour. Amer. Ceram Soc.*, **16** [1], 36–44 (1933).

Commercial underclays of Indiana. GEORGE I. WHITLATCH. *Jour. Amer. Ceram. Soc.*, **16** [1], 45–53 (1933).

Cretaceous and tertiary sediments of Kentucky, Illinois, and Missouri. J. A. LAMAR AND A. H. SUTTON. *Bull. Amer. Assn. Petroleum Geol.*, **14** [7], 845–66 (1930).—Outcrops of embayment sediments of Ky., Ill., and Mo. consist of the Tuscaloosa gravel, Eutaw and Ripley sands and clay of Cretaceous age, the Porters Creek clay and Lagrange sand and clay of Eocene age, and the "Lafayette" gravel and sand and the alluvium of Pliocene age forming an inverted U-shaped belt whose apex crosses southern Ill. and whose east and west sides lie, respectively, in western Ky. and southeastern Mo. The outer side of the U is bounded by Paleozoic strata. The source of the sands and clays is thought to be the Pennsylvanian and Upper Mississippian sandstones and shales of the adjoining parts of Ill., Mo., and Ky. Limestones have probably contributed to the clays. G.M.H.

Earth cracks in Mississippi. WATSON H. MONROE. *Bull. Amer. Assn. Petroleum Geol.*, **16** [2], 214–15 (1932).—Some exceptional cracks in the Yazoo clay member of the Jackson formation on Ware Hill, Rankin County, Miss., are discussed. No explanation is as yet acceptable. G.M.H.

Building of Mississippi delta. ARTHUR C. TROWBRIDGE. *Bull. Amer. Assn. Petroleum Geol.*, **14** [7], 867–901 (1930).—An explanation of the method and rate of delta building is attempted. G.M.H.

Mineralogy of typical North Carolina clays and shales. W. L. FABIANIC AND N. H. STOLTE. *Jour. Amer. Ceram. Soc.*, **16** [1], 6–11 (1933).

Southward extension of Bonham clay, Texas. C. I. ALEXANDER AND J. P. SMITH. *Bull. Amer. Assn. Petroleum Geol.*, **16** [2], 205–206 (1932).—The Bonham clay is traceable as a distinct member of the Austin formation as far south as McKinney, Tex. Through its southern extension it becomes gradually thinner, merging into the chalk above and below. G.M.H.

Zonolite. ANON. *Refrig. Eng.*, 323 (Nov., 1931); *Internat. Bull. Refrig.*, **13**, 312–13 (1932).—A material analogous to kieselguhr is mined by Schundler of Joliet, Ill. It fuses at 2600°F, but its chief characteristic is its expansion under heat to 12 to 15 times its natural size. H.H.S.

The Wilberforce radium occurrence. HUGH S. SPENCE AND R. K. CARNOCHAN. *Can. Mining Met. Bull.*, No. 217, pp. 649–88 (1930).—A radium deposit in Haliburton County, Ontario, suggests commercial possibilities. The ore is uraninite occurring in a lead at least 500 ft. long. Milling treatment is simple. Tests by the Dominion Government Mines Branch on a carload of ore indicate that one gram of radium would be recoverable from 3422 tons of ore. The world market and supply of radium and uranium are discussed. G.M.H.

Radium. G. W. ADAMS AND M. S. STEVENS. *Can. Mining Met. Bull.*, No. 234, pp. 1149–94 (1931).—A complete study is made of the chemistry and properties, uses, geology, and occurrence of radium, with particular reference to the Wilberforce, Ontario, deposit. There is appended an excellent list of radioactive minerals. G.M.H.

China clay in Quebec. ANON. *Can. Mining Jour.*, **51** [4], 86 (1930).—A large body of kaolin and shattered quartzite occurs at St. Remi d'Amherst. Unsuccessful efforts have been made to operate it. It is possible that the deposit could be operated successfully. G.M.H.

Clays of Ontario and Quebec described at Canadian Ceramic Society convention.

R. J. MONTGOMERY. *Clay Prod. News*, **5** [4], 3 (1932).—A summary of two lectures by M. on the clays of Ontario and Quebec is given. W.W.M.

Diatomite in ceramics. V. CHARRIN. *Céram. Verrerie*, No. 834, pp. 685–86 (1931).—C. discusses the formation, characteristics, and uses of diatomaceous earth. M.H.B.

Diatomite. V. L. EARDLEY-WILMOT. *Can. Mining Jour.*, **52** [26], 701–706 (1931); for abstract see *Ceram. Abs.*, **11** [2], 131 (1932). G.M.H.

Lithium in Quebec. ANON. *Can. Mining Jour.*, **51** [7], 152 (1930).—Lepidolite occurs and has been opened up in a pegmatite dike north of Ottawa in Wakefield township. It may have commercial possibilities. The lithia content is 5.44%. G.M.H.

Tin, lithium, and beryllium deposits of southeastern Manitoba. J. F. WRIGHT. *Can. Mining Jour.*, **51** [21], 514–17 (1930).—Pegmatite dikes are described which contain interesting and, in some cases, commercial quantities of tin, lithium, or beryllium. G.M.H.

Brazilian chromium ores. FRED W. FREISE. *Metall Erz*, **29** [21], 456–59 (1932).—The mode of occurrence of these ores is described. Chemical analyses are given. The economics of their recovery are discussed. L.T.B.

Origin and deposits of feldspar in regard to their action in the industry of fused silicates. C. GENSER. *Glashütte*, **61**, pp. 261–63, 278–80, 332–33, 350–53 (1931).—After a discussion of the chief types of feldspars, their constitution and mineralogy, the physical and chemical problems related to the genesis of feldspars, *e.g.*, their optical behavior during heating, determination of the melting point, and the melting of potassium feldspars are treated. The chief European (mainly German) deposits and the properties of different feldspars are discussed. The qualities of feldspar used in the ceramic industry are enumerated. The calcining test is stressed as necessary for determining the iron content. The question of mica and clay substance is of great importance. M.V.K.

Raw materials in ceramics. V. CHARRIN. *Céram. Verrerie*, No. 836, pp. 71–75 (1932).—Feldspar, quartz, kieselguhr, etc., are briefly discussed as to their composition and uses. M.H.B.

Fluorspar and its use in ceramics. CHERMETTE AND SIRE. *Mines, Carrières, Grandes Entreprises*, October, 1931; abstracted in *Ind. chimique*, **19** [221], 429 (1932).—Fluorspar considerably lowers the melting point of glasses. In certain amounts it opacifies glass and renders it opaque like porcelain. The field of application of opaque glasses is large. Fluorspar is also used in the enameling of cast iron, steel, and sheet metals for cooking utensils where it advantageously replaces antimony oxide. Fluorspar is also utilized in the manufacture of brick, tile, and stoneware. M.V.K.

Purifying fluorspar for ceramics. ANON. *Pottery Gaz.*, **57** [666], 1503 (1932).—A brief description is given of two methods of purifying fluorspar, *i.e.*, by flotation and by decrepitation. E.J.V.

Synthetic kaolin. H. BAUSCH. *Giorn. chim. ind. applicata*, **14** [8], 427 (1932).—Artificial kaolin has been successfully prepared by Noll by heating an adsorption compound of clay and silicic acid for 5 days. See also *Ceram. Abs.*, **11** [12], 633 (1932). M.V.K.

Deposits of magnesite in Jugoslavia. ANON. *Tonind.-Ztg.*, **56** [83], 1033 (1932).—A new railroad will make it possible to exploit the large deposits of magnesite near Cacak, Jugoslavia. W.M.C.

Magnesite and siderite of the Alps: comparative study of deposits. W. PETRASCHECK. Abstracted from *Sitzber. Akad. Wiss. Wien.*, Abt. I, **141** [3–4], 195–240 (1932); *Feuerfest*, **8** [9], 140 (1932).—The genesis of the different magnesite and siderite deposits of the Alps is reviewed. A literature index is given. M.V.K.

Statistical observations on the plagioclases. M. SOLIGNAC. *Bull. soc. franç. minéral.*, **55**, 22–85 (1932).—Variations in anorthite content are studied mathematically. R.H.E.

Zirconium oxide, its production and utilization. H. TRAPP. *Metallbörse*, **21** [8], 1565 (1931); abstracted in *Metals & Alloys*, **3** [8], 256 (1932).—The properties of zirconium oxide, its commercial application, and natural occurrence are reviewed. A detailed outline of the various chemical methods of preparing ZrO_2 is given. See also *Ceram. Abs.*, **10** [12], 859 (1931). E.P.R.

BOOKS

Textbook of Geology. Part I. Physical Geology. C. R. LONGWELL, A. KNOPF, AND R. F. FLINT. John Wiley & Sons, New York, N. Y. 514 pp. Price $3.75. *Mining & Met.*, **13** [312], 3 (1932). E.J.V.

Principles of Structural Geology. C. M. NEVIN. Reviewed in *Can. Mining Jour.*, **52** [29], 868 (1931); see also *Ceram. Abs.*, **11** [7], 427 (1932). G.M.H.

Report of the Committee on Sedimentation, 1929–1930, Division of Geology and Geography. ANON. Nat. Research Council *Reprint & Circular Series*, No. 98 (1931); abstracted in *Bull. Amer. Assn. Petroleum Geol.*, **16** [2], 217 (1932). G.M.H.

Clay and Shale Resources of Turner Valley and Nearby Districts. W. G. WORCESTER. 126 pp. F. A. Acland, Govt. Printer, Ottawa, 1932. Price 20¢. Reviewed in *Times Lit. Supp.*, **31**, 627 (1932). H.H.S.

Feldspar mining and milling in Canada. NORMAN B. DAVIS. *Can. Mining Met. Bull.*, No. 231, pp. 862–73 (1931).—Canadian feldspar production has consisted mainly of the high-potash, relatively low-soda variety. About 80% of the production has been exported to the U. S., but with increased milling facilities in Canada and changes in the U. S. sources of supply the proportion should be reduced. A short history of mining feldspar in Canada is given. Most of the Canadian deposits have been worked by the open-pit method, using derricks for hoisting. Sorting is usually done in the pit under shallow trays. The Derry mine at Buckingham, Quebec, has been developed underground since 1926 to a depth of 200 ft. on the incline. At this mine the rock is mined by drifting and underhand stopping. The output is about 40 tons of No. 1 feldspar per 10 hr. day. Two grinding plants are in existence, one at Kingston, Ontario, the other at Buckingham, Quebec. At the latter plant, quartz also is ground. The former plant grinds feldspar from the Verona and Perth districts of Ontario, the latter from the Buckingham district. G.M.H.

Geology and Minerals of Manitoba. W. L. GOODWIN. 260 pp. Industrial and Educational Publishing Co., Gardenvale, Quebec, 1930. Reviewed in *Can. Mining Met. Bull.*, No. 220, pp. 986–87 (1930). G.M.H.

Lithium. Issued by the IMPERIAL INSTITUTE. H. M. Stationery Office. Price 6d. Reviewed in *Metal Ind.* [London], **41** [12], 278 (1932).—The general properties, occurrence, sources, preparation, uses, production, and marketing of lithium are treated. Lithium minerals and compounds are used in the glass and ceramic industries, and its hydroxide in some types of alkaline accumulators. M.V.K.

Soils: Their Origin, Constitution, and Classification. G. W. ROBINSON. xv + 390 pp. Thomas Murby, London, 1932. Price 20s. Reviewed in *Times Lit. Supp.*, **31**, 667 (1932).—An introduction to petrology is presented. H.H.S.

Chemistry and Physics

Representation of soil analyses by the device of double plotting. W. HEBER GREEN. *Jour. Agric. Sci.*, **22** [3], 548–50 (1932).—In double plotting on rectangular coördinate paper, two points representing four constituents of the sample are connected by a straight line. In the example given, the silt and clay content of a sample are plotted as one set of coördinates to give a point while the coarse sand and the fine sand are plotted as another set on the same paper to the same scale to give another point. Connecting these points gives a straight line whose midpoint represents (on a half scale) the summation of all four values. The distance of this point from the diagonal line drawn through the 50% graduation on each axis gives a measure of the balance omitted. In the case graphed, the balance omitted is the loss on treatment with acid and hydrogen peroxide. J.L.G.

Effect of climatic variations on the plasticity of the soil. G. W. SCOTT BLAIR AND F. YATES. *Jour. Agric. Sci.*, **22** [3], 639–46 (1932).—It was found that soil in general has a higher plasticity in cold and dry weather and a lower plasticity in warm and wet weather. A bibliography on plasticity is appended. J.L.G.

Applications of rational analysis. W. PUKALL. *Sprechsaal*, **65** [43], 771–72 (1932).—In order to increase the usefulness of the rational analysis to the structural clay industry, P. suggests that CaO, Fe_2O_3, FeO, and MgO, when present, be listed as "fluxes of the second order," the feldspars and pegmatites forming the fluxes of the first order. Examples are given to show how this simplifies the calculations of the batch when it is desired to use cheaper substitutes in place of feldspars and pegmatites, such as granite, basalt, trachite, melaphyre, phonolith, shales, and others. W.W.B.

A rapid rational analysis. I. H. HARKORT AND H. J. HARKORT. *Sprechsaal*, **65** [39], 705–707 (1932).—The authors compare the different methods of rational analysis for clays commonly employed, such as the Berdel, the Kallauner (*Ceram. Abs.*, **10** [1],

68 (1931)), and the Keppeler-Gotthardt (*ibid.*, **11** [4], 277 (1932)) methods. The results obtained by these different methods do not agree, chiefly because none of them gives an accurate estimate of the amount of mica present. **II.** *Sprechsaal*, **65** [40], 723–26 (1932).—Different methods for the determination of mica in mixtures of kaolinite and mica are considered and the method based on loss of water of hydration on ignition is found to be sufficiently simple and accurate. A procedure incorporating this method for the determination of mica is developed. **III.** *Ibid.*, **65** [41], 739–41 (1932).—A summary of the procedure is given. A microscopic examination is first made to determine the nature of the mineral residues, to detect the presence of carbonates, and to approximate the scope of organic substances present. Several grams of the substance are dried to constant weight at 120 °C. The loss of weight on ignition is determined on a 0.5-gram sample after heating for 2 hr. at 220 °C, for 5 hr. at 500 °C, and again after 2 hr. at 1000 °C. For the sulfuric acid treatment a 1-gram sample is suspended in a little water and a drop of ammonium hydroxide is added; 20 cc. of concentrated sulfuric acid are added, and the mixture is kept close to boiling for 3 hr. and then heated until the sulfuric acid has been driven off. The residue is treated with 30 cc. of 37% hydrochloric acid, heated for 15 min., and filtered through a double filter into a 500-cc. flask. The alumina is determined in the usual manner in a portion of the filtrate by precipitating with ammonia. The filtrate may be used for the determination of MgO and CaO. Iron is determined titrimetrically on a portion of the first filtrate. SiO_2 from quartz and feldspar is determined in the residue from the first filtration in the usual manner. The data obtained are used as follows: Designating the loss in weight between 220 and 1000 °C by W, the Al_2O_3 from clay substance and mica by Al, and the quartz plus feldspar by R, then the amount of clay substance, $T = 10.80W - 1.27Al$, the amount of mica $G = 3.90Al - 11.06W$, and the alkaline earth content = 100 − ($T + G + R$ + organic substance). Designating the loss in weight between 220 and 500 °C by W_T and the loss between 500 and 1000 °C by W_G, $T = 7.2W_T$ and $G = 22.1W_G$. The analysis thus incorporates a check upon itself by giving two independent determinations of T and G. The accuracy of the method with respect to the content of quartz and feldspar (R) is about ±0.2%, with respect to the sum of clay substance and mica, about ±0.5%, and with the separation of these, about ±1.0%. The analysis may be carried out in 2 days, the actual work requiring 4 or 5 hr. W.W.B.

Action of phosphoric acid on ceramic raw materials and fired bodies and a new method of rational analysis of clays. HANS HIRSCH AND W. DAWIHL. *Keram. Rund.*, **40** [12], 149–51 (1932); see also *Ceram. Abs.*, **11** [9], 505 (1932). H.I.

Column curves and stress-strain diagrams. WILLIAM R. OSGOOD. Bur. Stand. *Jour. Research*, **9** [4], 471–82 (1932); R.P. 492.—The present paper examines a few of the commonest types of empirical formulas and determines the shape of the stress-strain diagram in each case which makes them compatible with the Considere-Engesser formula. R.A.H.

Clay colloids and their applications in ceramics. R. DUBRISAY. *Céramique*, **35** [530], 113–17 (1932).—Five grams of kaolin purified by Schloesing's method were blunged for 24 hr. in 150 cc. of distilled water. Twenty cubic centimeter volumes of the suspension so prepared were added to equal volumes of dilute acids and alkalis and the rate of descent of the plane of separation between clear liquid and suspension was measured. Rates of descent and p_H values are given for a number of such solutions; they were high for acid solutions, low about p_H 11, and high again in more concentrated alkalis. These conclusions were confirmed by nephelometer and microscopic and ultra-microscopic studies. Suspensions of clays in dilute ammonia show chatoyment and scintillation under the microscope since the flat plates place themselves at right angles to the lines of turbulence; in acid solution these effects are prevented by coagulation. Twenty grams of clay were shaken with 80-cc. volumes of various solutions for 12 hr. and the final volumes of the material settling from the solution were obtained. With alkaline solutions a pronounced minimum volume was found at certain concentrations but this was not the case in acid solutions. Centrifuging brought all the deposits to the same volume. D. advances the two following explanations for the phenomena: (1) In weakly alkaline solutions the particles show Brownian movement and exercise an osmotic pressure which compresses the precipitate. This is a generalization of the theory of the swelling of gels. (2) When deflocculated, the fine particles can arrange themselves so that they pack together better than flocculated particles. Both explanations may be true in part. X-ray studies confirmed the lamellar structure of the precipitates. D. points out the practical applications of his experiments and describes other experiments showing a definite relation between consistency and degree of flocculation. See also *Ceram. Abs.*, **10** [12], 862 (1931). A.E.R.W.

Absorption studies on colloidal clay. E. UNGERER. *Angew. Chem.*, **45** [42], 662 (1932).—The fractions of particle size $< 0.2\mu$ and 0.2μ to 2.0μ were separated from a clay which was enriched with Ca and Na. The colloidal fraction $< 0.2\mu$ is very reactive. The adsorption of basic colors (methylene blue) takes place with cation exchange. Clays enriched with Na are more reactive than Ca-clays. Difficultly soluble salts such as $BaSO_4$, $BaCO_3$, $CaCO_3$, and $Ca_3(PO_4)_2$ are enclosed by colloidal clay in aqueous suspensions and the anion is liberated. This takes place with base exchange. The reaction is of importance for the explanation of the mobility of the anions, especially the phosphoric acids in the soil, as well as for the explanation of the origin of alkali soils. L.T.B.

Shrinkage of ceramic bodies. RUDOLF SCHNEIDER. *Keram. Rund.*, **40** [11], 142–44 (1932).—A method is considered of determining loci of failure in ceramic bodies through analysis of stresses produced in drying and firing shrinkage by the shapes of bodies and methods of forming. H.I.

Cohesive force between solid surfaces and the surface energy of solids. R. S. BRADLEY. *Phil. Mag.*, **13**, 853–62 (1932).—An expression for computing the cohesive force between two solid surfaces was derived. Such forces were measured for spheres of fused silica and sodium pyroborate. From the measurements of the cohesive forces the surface energy could be computed. The results were found to be 33.8 and 69 c.g.s. per sq. cm. for the fused silica and sodium pyroborate, respectively. J.T.L.

Molecular dynamics in crystals. G. TAMMANN. *Nachr. Ges. Wiss. Göttingen, Math.-physik. Klasse*, pp. 227–54 (1930); abstracted in *Glastech. Ber.*, **9** [4], 236 (1931).—This work gives a comprehensive summary of the studies of T. and his assistants on the phenomena of the exchange of places of atoms in crystals, including the action of these phenomena on physicochemical processes such as the baking of crystal powders, processes of transformation, and interior diffusions. M.V.K.

Research problems in applied chemistry. G. T. MORGAN. *Jour. Soc. Glass Tech.*, **16** [63], 272–83 (1932). G.R.S.

Method for determination of chromium in minerals and rocks. H. LEITMEIER AND F. FEIGL. *Mineralog. petrog. Mitt.*, **41** [1], 95–102 (1931); *Glastech. Ber.*, **10** [7], 394 (1932).—A simple test for determining chromium in minerals and rocks depends upon the change in color from red to violet of an alcoholic solution of diphenylcarbazide by the action of chromates. This reaction can serve for the detection of chromium-bearing minerals as well as the testing of the smallest amount of this metal in an alloy. G.R.S.

Silicides of the earth alkalis. LOTHAR WOHLER AND W. SCHUFF. *Z. anorg. allgem. Chem.*, **209** [1], 33–59 (1932).—The methods of preparation of calcium, barium, and strontium silicides and the determination of the heats of formation of the various compounds which exist are presented. A study was also made of the dissociation of the oxalates of calcium, barium, and strontium. In vacuum, calcium oxalate begins to dissociate at 380°, strontium oxalate at 400°, and barium oxalate at 425°. The carbonates of these metals begin to dissociate in vacuum at 550° for calcium carbonate to 650° for strontium and barium carbonates. L.T.B.

Errors in volumetric lead determination. H. E. FRENCH. *Can. Mining Jour.*, **53** [11], 504–508 (1932).—Causes of erratic results in the titration of low lead-content samples are discussed. Filtered at 93°C without alcohol the average loss of lead sulfate is 2.9 mg. per 75 cc. of solution containing 10 cc. H_2SO_4. With 10 cc. ethyl alcohol the average loss is 2.4 mg. Filtered at 23°C without alcohol the average loss is 1.7 mg. With 10 cc. ethyl alcohol the average loss is 1.15 mg. Loss of lead sulfate varies directly as the volume and inversely as the concentration of sulfuric acid for dilute solutions. For consistent results conditions must be standardized. A large sample gives more accurate results but is difficult to handle. A one-gram sample will give an accurate result if corrections are made for solution loss and the lime present. Samples containing less than 0.3% Pb may be run by adding a known amount of lead and deducting its value from the total titration. Accuracy approaching the electrolytic is possible. The correction for lime appears to be practically constant up to about 15% CaO and is equivalent to 0.04 to 0.08% Pb. Graphite is removed easily by adding crystals of $KClO_3$ to the sample while fuming strongly. A moderate number of washings has slight effect on the solubility of the lead sulfate. Washing with dilute sulfuric acid or alcohol has little effect in decreasing the loss. Excess ammonium acetate retards the titration. Blank on 0.001 ammonium molybdate solution is 0.6 cc. The strength of ammonium molybdate solution is determined with C.P. lead sulfate dissolved with ammonium acetate and titrated. G.M.H.

Separating titanium from aluminum according to the oxyquinolin-acetate method.

HERMAN WABNITZ. *Sprechsaal*, **65** [32], 594 (1932).—The precipitation with oxyquinolin acetate used for separating titanium from aluminum has a great advantage over other methods. The solution to be investigated is treated with 1 g. tartaric acid, malonic acid, and about 1 g. sodium acetate. The solution is diluted, neutralized with ammonia, and acidified with 1 or 2 cc. glacial acetic acid; phenolphthalein is used as indicator. It is heated to 60° and a mixture of oxyquinolin acetate solution with surplus alcohol is added. The precipitate is boiled and kept 10 min. in ebullition. This is necessary to transform the precipitation of titanium oxyquinolate into a macrocrystalline state. The precipitate is filtered hot and washed in hot water until it is as colorless as the wash water. The precipitate of titanium oxyquinolate is dissolved in concentrated HCl and titrated after being diluted. For this purpose, 20 to 30 cc. of normal 5 potassium bromide bromate solution are used, and dibromoxyquinolin is formed. A surplus of bromine in the form of potassium bromide bromate solution is added. Bromine which is not combined in the oxyquinolin residue is liberated. Some cubic centimeters of concentrated potassium iodide solution are added; an amount of iodine equivalent to that of bromine is set free. Iodine is titrated back with sodium thiosulfate. A starch solution is added at the end of the reaction and titrated to colorlessness. The sodium thiosulfate used is abstracted from the potassium bromide bromate solution present and the potassium bromide bromate used is obtained. One cubic centimeter of normal 5 potassium bromide bromate solution corresponds to 0.001198 Ti. The filtrate contains aluminum as a soluble complex salt. It is precipitated by adding ammonia and an oxyquinolin acetate solution at 60° as aluminium oxyquinolate. The deposit is filtered cold and washed with water to colorlessness. It is dissolved in hot diluted HCl and titrated cold in the presence of potassium bromide bromate solution with sodium thiosulfate. M.V.K.

Colorimetry of titanium. H. GINSBERG. *Z. anorg. allgem. Chem.*, **209** [1], 105–12 (1932).—A new theory of colorimetry which has recently appeared in the literature is discussed. G. has found that the Lambert-Beer law holds for concentrations greater than 3 mg. TiO_2/100 cc., while below that concentration deviations enter due to deficiencies of the apparatus. L.T.B.

Magnesite analysis. ANON. *Ind. chimique*, **19** [224], 706 (1932).—The method of Heilingoetter for determining small quantities of CaO in magnesite is described: 1 g. of magnesite is dissolved in dilute HCl, dried to render the SiO_2 insoluble, and treated again with concentrated HCl. After several minutes water is added. It is heated to boiling, and the SiO_2 and the silicates remaining undissolved are filtered. One gram of ammonium chloride is added to the filtrate and the iron and aluminum are precipitated with ammoniac; these hydroxides are again redissolved in HCl and reprecipitated with ammoniac. Twenty grams of oxalate of ammonium are added to the filtrates and boiled till dissolution. The oxalate of lime is filtered off after 30 min. The precipitate is redissolved in HCl and precipitated again with half of the reagent till constant weight is attained. Magnesia results from the difference after adding the determined compounds: loss on ignition + compounds insoluble in HCl + Fe_2O_3 + Al_2O_3 + CaO + SO_3. M.V.K.

Determination of magnesia in phosphate rock. JAMES I. HOFFMAN. Bur. Stand. *Jour. Research*, **9** [4], 487–91 (1932).—Calcium is separated as sulfate in alcoholic solution, and magnesium is determined in the filtrate by precipitating it as magnesium ammonium phosphate. R.A.H.

Studies on the hydrothermal synthesis of calcium silicates at ordinary pressure.. IV. S. NAGAI. *Jour. Soc. Chem. Ind.* [Japan], **35** [7], 320–26 (1932).—N. reports the results of studies on (1) the products obtained by prolonged heating of the mixture $CaO:SiO_2$; (2) the products obtained at ordinary pressure by heating the mixtures 1.25 $CaO:SiO_2$ and 1.75 $CaO:SiO_2$; (3) the fractional separation of the various calcium silicates; and (4) the determination of the percentages of silicates in these products by the fractional separation method which is described. **V.** *Ibid.*, **35** [8], 380–84 (1932).—Results are given of studies on (1) the silicates produced by hydrothermal treatment at ordinary pressure of the mixture (*c*) $3CaO:2SiO_2$ at temperatures from 900 to 1200°C; (2) a comparison of the silicates produced by heating in water vapor the mixture (*c*) $3CaO:2SiO_2$ at 1200°C, and those produced by heating the same mixture at 1420 to 1450°C without water vapor; and (3) the fractional separation and the determination of the percentages of the mixed silicates. For Parts II and III see *Ceram. Abs.*, **11** [8], 440 (1932). M.V.K.

Studies on the hydrothermal synthesis of lime and kaolin or alumina. III. S. NAGAI. *Jour. Soc. Chem. Ind.* [Japan], **35** [9], 394–98 (1932).—The results of comparative studies on the hydrothermal combinations between lime and raw or calcined kaolin under various conditions of pressure, temperature, time, and mixing proportion are given. For Part II see *Ceram. Abs.*, **11** [10], 515 (1932). M.V.K.

Analysis of silicate bases using oxyquinolin. A. GRANGER. *Céram. Verrerie*, No. 837, pp. 137–38 (1932).—Oxyquinolin (C_9H_7ON) forms stable compounds with metals. These are readily separated and may be determined volumetrically or gravimetrically. A plan of analysis is given. M.H.B.

Experiments on use of caustic alkalis as fluxes in silicate analyses. W. MYLIUS. *Keram. Rund.*, **40** [3], 33–35 (1932).—Caustic alkalis may be substituted for alkali carbonates in the decomposition of many silicates with consequent reduction of the fusion temperature, avoidance of spattering, and volatilization of many substances. Harm to the Pt crucible is also avoided when Pb, Sb, and Zn compounds are present. H.I.

Constitution of silicates in the light of crystallographic studies. W. EITEL. *Angew. Chem.*, **45** [39], 621 (1932); for abstract see *Ceram. Abs.*, **11** [10], 542 (1932). L.T.B.

Ultra-violet indices of refraction of zircon and beryl. A. BRUN. *Bull. soc. franç. minéral.*, **54**, 189–90 (1931).—For 2967 Å zircon gave $N_\omega = 2.0989$ and $N_\rho = 2.0394$ and beryl gave $N_\rho = 1.6211$. R.H.E.

The system FeO–SiO_2. N. L. BOWEN AND J. F. SCHAIRER. *Amer. Jour. Sci.*, **24** [141], 177–213 (1932).—Use was made of crucibles of pure electrolytic iron as containers for the melts. The work was carried out in an atmosphere of pure nitrogen as a protection against oxidation. It was found that iron can not reduce all the iron oxide of the melts to the ferrous condition and that all melts in equilibrium with iron contain some Fe_2O_3. Because of this fact, the composition of the liquid can not be fully expressed as a binary system, the full relationship being expressed only by the aid of a ternary diagram in which FeO, Fe_2O_3, and SiO_2 are the components. When no silica is present the amount of Fe_2O_3 in the liquid is at its highest, and the solids in equilibrium here are wüsite (FeO in solid solution) and iron, and the content of Fe_2O_3 in the liquid is 11.5%. As the concentration of SiO_2 increases, the Fe_2O_3 in the liquid rapidly decreases, as wüsite and iron are the solid phases in equilibrium. When fayalite and iron become the solid phases, the amount of Fe_2O_3 does not decrease so rapidly with increasing silica concentration. When SiO_2 and iron are the only solid phases, Fe_2O_3 falls off at a still slower rate. With compositions close to fayalite, the amount of Fe_2O_3 in the liquid is about 2.25%. The pure compound, Fe_2SiO_4, melts incongruently with the separation of iron. The departure from a truly binary system is small, especially in the region of high silica. The FeO–SiO_2 diagram is drawn showing one compound at composition Fe_2SiO_4 which melts at 1205 ± 2°C, a eutectic between Fe_2SiO_4 and tridymite at 1178°C at the composition of 62% FeO and 38% SiO_2, and a eutectic between Fe_2SiO_4 and wüsite at 1177°C at composition 76% FeO and 24% SiO_2. C.G.H.

Chemically different and variously colored chromium hydroxides. A. HANTZSCH AND E. TORKE. *Z. anorg. allgem. Chem.*, **209** [1], 60–94 (1932).—Well-defined chromium oxide hydrates have been prepared which are distinct from each other chemically. They may also be differentiated by their color. Dehydration curves were made on the preparations. Detailed data on the changes in composition and properties on aging are given. L.T.B.

Preparation of pure ytterbium oxide. WILHELM PRANDTL. *Z. anorg. allgem. Chem.*, **209** [1], 13–16 (1932).—The preparation of C.P. ytterbium oxide by means of electrolysis is described. L.T.B.

Separation of hafnium and zirconium. WILHELM PRANDTL. *Z. anorg. allgem. Chem.*, **208** [4], 420–26 (1932).—A method is given for the separation of the two elements by means of a ferrocyanide precipitation. The density of pure ZrO_2 is 5.4 and that of HfO_2 is 9.4. L.T.B.

Quantitative determination of potassium with complex compounds of lead. P. S. SERGUEIENKO. *Naouk. Zap. Tsoukr. Prom.*, No. 15, pp. 85–89 (1932); abstracted in *Chim. & ind.*, **28** [5], 1048 (1932).—S. describes a volumetric method for the rapid determination of potassium which is precipitated in the state of a double cobaltic nitrite of potassium and of lead. The presence of chlorides, sulfates, and other salts forming insoluble compounds with lead does not affect the determination. M.V.K.

Determination of sulfate as $BaSO_4$. J. N. FRIEND AND W. N. WHEAT. *Analyst*, **57**, 559–62 (1932).—Precautions are outlined against adsorption of impurities by the $BaSO_4$ precipitate. H.H.S.

New analytical group with tannin reagent. W. R. SCHOELLER AND A. R. POWELL. *Analyst*, **57**, 550–54 (1932).—Tannin quantitatively precipitates Ta, Nb (Cb), and Ti from a barely acid oxalate solution half-saturated with NH_4Cl. This is called the acid tannin group. The basic tannin group, consisting of Zr, Hf, Th, Al, and U, is precipitated on making the filtrate faintly alkaline with NH_4OH. H.H.S.

Rapid method of dissolving lead alloys. B. S. EVANS. *Analyst*, **57**, 554–59 (1932).—Perchloric acid is used under conditions of security against explosion. H.H.S.

Production of red cadmium pigments. ANON. *Ind. chimique*, **19** [220], 386 (1932).—The Haen plant manufactures a vivid red pigment from cadmium sulfide and selenium sulfide which is known as cadmium red, fire red, and selenium red. The pigment is produced by heating to 700° in a muffle furnace 80 or 90 parts of cadmium sulfide with 10 to 20 parts selenium. The colors obtained vary between red-orange and dark red-purple and are used as coatings for colorless glass or for the manufacture of colored artistic glass. See also *Ceram. Abs.*, **11** [2], 73 (1932). M.V.K.

Fixation of organic dyes by argillaceous materials. A. DE RASSENFOSSE. *Ann. soc. géol. Belg.*, **55**, 94–121 (1931).—Experiments were made on the coloration of fired and raw clays with fuchsin, methylene blue, and methyl violet. Observations were made on color zones formed during sedimentation of colored clay suspensions. R.H.E.

BOOKS

Atomic Reactions. MICHAEL POLANYI. Williams and Norgate, London, 1932. 64 pp. Price 6s net. Reviewed in *Chem. Trade Jour.* [London], **91** [2369], 355 (1932).—With the development of newer conceptions of valency, modified ideas as to the nature of atomic reactions are gaining currency. The theories of Heitler and London, in particular, have led to deductions on atomic reactions valid in the field of kinetics. In the present book P. deals not only with the newer theory but with the extent to which it has been supported by recent experimental observations. There are three sections, (1) the theory of chemical reactions, (2) atomic reactions without appreciable inertia, and (3) atomic reactions possessing energy of activation. The new theories have as their principal viewpoint the existence of a force so influencing the reacting system that the configurational difference between intermolecular and intramolecular distances tends to vanish. M.V.K.

Technical Industrial Materials. (Die technischen Werkstoffe.) O. SCHWARZ. Johann Ambrosius Barth, Leipzig, 1932. 222 pp. Unbound 23 Rm., bound 24.5 Rm. Reviewed in *Chim. & ind.*, **28** [5], 1102 (1932).—S. has condensed all the technical knowledge indispensable to industry and to the constructor on the use of materials of different nature. In the first part of the book, the mechanical, magnetic, electrical, and technological characteristics of the materials are defined. The second part deals with ferrous metals (carbon steel, cast metal, special steel), the nonferrous metals (nickel and its alloys, bronze, copper, and light metals), nonmetallic materials (wood, paper, ebonite, rubber, etc.), and materials having a mineral nature (clay, brick, cement, concrete, glass, and porcelain). The third part is devoted to testing apparatus and measuring methods. M.V.K.

Methods of Calculation and Aids to Computation with Applications to Analytical Chemistry. (Rechenverfahren und Rechenhulfsmittel mit Anwendungen auf die analytische Chemie.) OTTO LIESCHE. Die Chemische Analyse. Band XXX. 210 pp. Ferdinand Enke, Stuttgart, 1932. Reviewed in *Jour. Phys. Chem.*, **36** [7], 2108–2109 (1932).—Arithmetical processes as applied to chemical science are treated. G.R.S.

Chemical Encyclopedia: A Digest of Chemistry and Its Industrial Applications. C. T. KINGZETT. 5th ed. *Nature*, **130** [3291], 795 (1932); for abstract see *Ceram. Abs.*, **11** [12], 642 (1932). J.L.G.

Colloid Chemistry, Theoretical and Applied. Vol. IV. JEROME ALEXANDER. Reviewed in *Analyst*, **57**, 601–602 (1932); for abstract see *Ceram. Abs.*, **11** [10], 543 (1932). H.H.S.

Applied Colloid Chemistry. General Theory. W. D. BANCROFT. 3rd ed. McGraw-Hill Book Co., New York, 1932. 544 pp. Price $4.00. Reviewed in *Jour. Phys. Chem.*, **36** [11], 2844 (1932); *Jour. West Soc. Eng.*, **37** [5], 287 (1932).

Quantitative Chemical Analysis. CLOWES AND COLEMAN. 13th ed. Revised by D. Stockdale and J. Dexter. xiv + 605 pp. J. & A. Churchill, London, 1931. Price 18s. Reviewed in *Analyst*, **57**, 597–600 (1932). H.H.S.

PATENTS

Method of producing refined clay. GEORGE SIMCOE (Edgar Brothers Co.). U. S. 1,888,701, Nov. 22, 1932. In the art of purifying and decolorizing clay, the improvement comprises subjecting the clay to at least partial deflocculation in the presence of water and removing more or less of the insoluble impurities by gravitative settling to produce a partially purified slip, treating the slip with sulfur dioxide whereby insoluble iron compounds are converted into soluble compounds, organic discoloration is removed, and the slip strongly flocculated, and treating the slip to partially re-deflocculate it and eliminate sulfur odors.

Process of making titanium white. S. J. LUBOWSKY (Metal & Thermit Corp.). U. S. 1,888,993, Nov. 29, 1932. In the production of titanium white by a process comprising hydrolysis of a solution of titanium and magnesium salts obtained by dissolving with acid a product produced by heating together titanium oxide and magnesium oxide, the improvement comprises heating the titanium-magnesium salt solution at a temperature above 100°C thereby precipitating a titanium compound, and thereafter digesting the precipitate with its mother liquor for an extended time under superatmospheric pressure and at a temperature corresponding thereto, thereby increasing the opacity and improving the pigmentary covering power of the precipitated product.

General

Soldered porcelain and glass in the electrical industry. E. H. FRITZ. *Ceram. Ind.*, **19** [6], 279–83 (1932).—The process consists of producing a metallized area on glass or glazed porcelain surfaces which can be tinned and soldered to metal parts with a commercial solder. The metallized area is produced by coating the glass or glazed porcelain surface with a special metallic glaze of comparatively high metallic content of which the essential constituents are platinum and gold in the form of chlorides. This glaze is fired in an oxidizing atmosphere. The commercial solder consists of approximately half tin and half lead. A satisfactory union takes place between the solder and metallic glaze at 225°C and this temperature must be closely controlled. To overcome strains due to different coefficients of expansion of metal and nonmetal parts the former are made as light as possible and the latter with the maximum sturdiness. Examples of parts made by this process are illustrated photographically and explained. W.W.M.

Progress in kaolin refining. J. K. TOWERS. *Rock Prod.*, **35** [23], 14–17 (1932).—T. relates the progress in practice in kaolin refining in the S. C. and Ga. districts. He divides the process into the three stages, mining, drying, and grinding. Producers require equipment which differs from their competitor's, and efforts to produce superior material result in constant changing of refining processes. The changes which have been made in the three different steps of production are outlined. The rotary drier is said to be the most important change in processing equipment, due to its saving in time. In the grinding is found the largest variety of methods used in any of the three steps. Air separators are often used in series with grinding equipment. Besides rotary driers, rack type and tunnel type driers are employed. Filtering and thickening, as carried out in the wet process, are described, as are wet reclamation of toilings and mining of overburden and kaolin. Some figures are given on the cost of drying the kaolin in rotary driers. The introduction of a conical pebble mill in the processing circuit is suggested as a possibility of improving the product. Several flow sheets, both wet and dry, are given in detail. W.W.M.

Filtering and drying raw clay. GEORGE W. O'KEEFFE. *Ceram. Ind.*, **19** [6], 289–90 (1932).—Wet processing of raw clay is described with special emphasis on automatic and continuous filtering in conjunction with rotary drum drying. This process fixes the drying time and conditions the clay uniformly. W.W.M.

Synthoporite, a new light material. H. F. KRAUSE. *Internat. Bull. Refrig.*, **13**, 314 (1932); for abstract see *Ceram. Abs.*, **10** [10], 735 (1931). H.H.S.

Velocity of migration of suspended dust particles in electric filters. G. MIERDEL. *Z. tech. Physik*, **13** [11], 564–67 (1932).—Experiments were conducted by means of a tube-shaped filter. Migration velocities were determined for three different sizes of dust particles. A comparison of the values obtained with the theoretical values shows a very close agreement. There is nothing that would indicate the possibility of additional influences in the action of the filters, *i.e.*, the electric wind is of no importance, contrary to the theory of Ladenburg. See also article by Ladenburg and Tietze, *Ceram. Abs.*, **10** [10], 734 (1931). W.M.C.

Using pipe as beams. M. BARRY WATSON. *Heating, Piping, Air Conditioning*, **4** [10], 667–69 (1932).—The safe use of pipe as beams for supporting tanks and other heavy equipment is considered. A table of safe loads for pipe used as beams is given. Illustrated. J.L.G.

Generation of steam by blast-furnace gas. A. F. WEBBER. *Mech. World*, **92** [2387], 320–22 (1932). E.P.R.

Use of waste heat in the ceramic industry. C. HÜTTER. *Tonind.-Ztg.*, **56** [87], 1074–76; [89], 1098–99 (1932).—Several examples of waste-heat installations are described. The operating costs and the savings are calculated. Illustrated. W.M.C.

Cutting heating and compressed air cost with waste-heat boilers. THOMAS R. SHAVER. *Heating, Piping, Air Conditioning*, **4** [11], 728–30 (1932).—Illustrated. J.L.G.

Decomposition of sodium carbonate in steam boilers. REINHOLD F. LARSON. *Trans. A.S.M.E.*, **54** [16], 171–79 (1932); for abstract see *Ceram. Abs.*, **11** [9], 508 (1932). E.P.R.

Corrosion from flue gases. ANON. *World Power*, **27** [2], 122 (1932); abstracted in *Metals & Alloys*, **3** [10], 291 (1932).—Sulfur and moisture inevitably occur in flue gases. When gases are reduced to the dew point of the vapor, the combination of the S (whether existing as SO_2 or SO_3) will occur, forming a corrosive acid solution. To avoid such corrosion heat the feedwater to at least 100°F, preferably 120°F, with cast-iron economizers, and with steel, 130 to 140°F. The decrease in the efficiency of the heat exchange is less serious than occurrence of corrosion. E.P.R.

Boring map for clay and loam deposits. ANON. *Tonind.-Ztg.*, **56** [78], 973–74 (1932).—In this paper the carrying out of borings and the designing of a map showing the results are described. W.M.C.

Rehabilitation and improvement of power plants. CHARLES W. E. CLARKE. *Power Plant Eng.*, **36** [18], 699–702 (1932).—Better combustion, heat reclamation, higher pressures, and greater thermal efficiency and output are results to be sought in consideration of future power-plant construction. Modernization of many present power plants is considered. E.P.R.

Control of the silicosis hazard in the hard rock industries. II. Investigation of the Kelley dust trap for use with pneumatic rock drills of the "jackhammer" type. THEODORE HATCH, GEORGE S. KELLEY, AND J. WILLIAM FEHNEL. *Jour. Ind. Hygiene*, **14** [2], 69 (1932); *U. S. Pub. Health Eng. Abs.*, **12** [1HS:4], 1 (1932).—The dust-collecting efficiency of the Kelley trap for use with pneumatic rock drills of the jack-hammer type is investigated. The Kelley trap is a metal chamber designed to enclose the drill steel at the rock surface from which the dust is removed by an air stream which discharges into a trap. The minimum rate of air flow necessary to keep the dust concentration at the breathing zone of the drill operator safe was investigated and found to be 60 cu. ft./min. Check tests were run with the trap operating at that speed in connection with two actual jobs, and satisfactory results were obtained. Static suction requirements for various rates of air flow were also determined. H.F.V.

Dust hazard in rock products industry. ANON. *Rock Prod.*, **35** [21], 14–17 (1932).—A digest is given of the papers and discussions at the National Safety Congress at Washington, D. C. Only dusts containing silica are dangerous as causes of tuberculosis or silicosis. W.W.M.

Proposed revision of the Constitution and By-Laws of the American Ceramic Society. ANON. *Bull. Amer. Ceram. Soc.*, **11** [12], 270–72 (1932).

Trade and technical association activities. EMERSON P. POSTE. *Bull. Amer. Ceram. Soc.*, **11** [12], 265–68 (1932).

Technical organizations of the ceramic industry. L. DESMARQUEST. *Céramique*, **35** [533], 183–86 (1932).—A description is given of the Official Test Laboratory (Laboratoire Officiel d'Essais), the Technical Service (Service Technique), and the Assn. of Technical Instruction in Ceramics (l'Association d'Enseignement Technique Céramique). A.E.R.W.

Developments in the ceramic industry. ANON. *Ceram. Ind.*, **19** [5], 219 (1932).—*Ceramic Industry* presents the developments that have been made during the past year in the ceramic industry. W.W.M.

Production of ceramic ware. FERRUCCIO PALAZZI. *Ind. Silicati*, **10** [9], 13–14 (1932).—Present-day production of ceramic ware in Italy should be separated into the three following types: (1) popular production carried on by the peasants or country people in a small way when they are not occupied by farm work, thus furnishing a means of expression to the artisan in the fashioning of simple articles or ornaments; (2) industrial production on a large commercial scale; and (3) ceramic art production which should be brought back once more to the highest plane of Italian æsthetic, cultural, and social activity. A piece of ceramic art should not be valued as an object to sell, but as an enduring expression of the time and race. M.V.K.

Industrial coöperation in the field of applied science. P. BROCKHAUS. *Tonind.-Ztg.*, **56** [88], 1085–86 (1932).—The necessity of carrying out research work supported by the industry is pointed out. W.M.C.

Purchase of mechanical equipment for mines. D. S. HINES. *Can. Mining Met. Bull.*, No. 218, pp. 764–74 (1930).—Mechanical equipment plays an important part in mine operation and its purchase demands careful attention. The paper deals with

(1) the proper method of requisitioning on the purchasing department, (2) how to inquire among manufacturers for prices, (3) placing the order, (4) prices, terms, sales tax, and delivery, and (5) insurance, inspection, and customs regulations. G.M.H.

Unified bookkeeping system for fine dinnerware manufacturers. III. GERD ULRICI. *Keramos*, **11** [4–5], 81–103 (1932).—Expenses and income in a ceramic plant are listed under the following headings: (1) equipment, (2) raw materials, (3) payroll, (4) other expenses, and (5) performance. W.W.B.

Bookkeeping and calculation in the brick industry. M. J. BORCHERT. *Tonind.-Ztg.*, **56** [84], 1041–42 (1932).—Graphs show the calculation of the actual costs and the profit. See also *Ceram. Abs.*, **12** [1], 18 (1933). W.M.C.

Some application of industrial accounting in the ceramic industry. A. CARLIER. *Céramique*, **35** [534], 205–11 (1932).—An accounting scheme presented for a typical ceramic plant is explained in detail and illustrated by a numerical example. A.E.R.W.

Example of gain-sharing on maintenance construction work. ERNEST F. THAYER. *Maintenance Eng.*, **90** [11], 427 (1932).—Money saved on a maintenance job over the estimated cost is divided between the company and the men. J.L.G.

Are mergers a benefit to the heavy clay industry? II. RALPH E. KIRK. *Brick Clay Rec.*, **81** [5], 169–70 (1932); for Part I see *Ceram. Abs.*, **12** [1], 38 (1933). E.J.V.

Back to coöperation and common sense. GEORGE A. BASS. *Brick Clay Rec.*, **81** [5], 166–67 (1932); *Clay-Worker*, **98** [5], 182–83 (1932).—An appeal for a return to sound principles of doing business is presented as delivered at the American Face Brick Assn. convention. E.J.V.

Road to recovery. ANON. *Brick Clay Rec.*, **81** [5], 162–64 (1932); *Clay-Worker*, **98** [5], 179–82 (1932).—The report of the annual convention of the American Face Brick Assn. held at French Lick, Ind., Nov. 1–3, is replete with ideas of the improvement of the trade of the brick industry. E.J.V.

Ceramic engineer in Canadian industry. R. J. MONTGOMERY. *Can. Mining Jour.*, **51** [47], 1166 (1930).—Ceramic engineers are finding a responsible place in the Canadian industry. G.M.H.

Ceramics in Tonkin. V. CHARRIN. *Céram. Verrerie*, No. 842, pp. 417–18 (1932).—Ceramics in Tonkin are discussed, both from the standpoint of natural resources and products manufactured. M.H.B.

Japanese glass bulbs. ANON. *Ceram. Ind.*, **19** [5], 246 (1932).—Japanese lamp bulbs are being sold in this country for less than U. S. factories pay for their production. The foreign articles are of short life and have high current consumption, but the low price appeals to uninformed consumers. Imports from Japan this year constitute 20% of this country's demand; last year it was only 9%. W.W.M.

Ceramic Association of New Jersey. ANON. *Clay-Worker*, **98** [5], 189–90 (1932).—A report of the fall meeting shows that the chief topics of discussion were the process of de-airing and types of equipment for that purpose, the use of acids in connection with clayworking, hydraulic refractory cements, and mining Florida china clays. E.J.V.

Pottery and glassware shown at exposition. ANON. *Ceram. Ind.*, **19** [6], 292–94 (1932).—New bodies and colors were exhibited at the recent National Hotel Exposition held in New York City. The glassware manufacturers are preparing for the return of legal liquor. W.W.M.

Technical Congress of the Syndicate of French Ceramic Manufacturers. ANON. *Céramique*, **35** [532], 153–54 (1932).—A general account of the meeting is given. A.E.R.W.

Copenhagen British Exhibition. ANON. *Times Eng. Supp.* [Copenhagen Supp.], 24 pp. (Oct. 1, 1932).—The Danish porcelain industry is of international repute, and the local potteries supply the home market for best quality ware, but in earthenware and white tableware there is competition from abroad. A general summary of Danish industry is made, and an account of the British exhibits is given. H.H.S.

Impressions of the German Ceramic Society meeting. E. URBSCHAT. *Tonind.-Ztg.*, **56** [83], 1029–30; [85], 1053–54 (1932). W.M.C.

Tribute to "Pat" Murphy. W. KEITH MCAFEE. *Clay-Worker*, **98** [4], 144–45 (1932).—A brief eulogy of Joseph Lincoln Murphy, presented at the Ohio Ceramic Industries Assn. meeting, is given. E.J.V.

BULLETINS

Research activities in the mineral industries of the United States. A. C. FIELDNER AND A. H. EMERY. Bur. Mines *Information Circ.*, No. 6637. 285 pp. Free. The

report lists the problems which are engaging the attention of the mineral industries. It was compiled from answers to questionnaires sent to industrial, institutional, university, and Government research departments, and prepared under sponsorship of the committee on correlation of research of the American Institute of Mining and Metallurgical Engineers. R.A.H.

Abstracts of recent articles on mine support. W. R. CRANE. Bur. Mines *Information Circ.*, No. 6651. 23 pp. Free. The report deals with papers on testing of materials of support, failure, movement of rocks above workings, the effect of excessive pressure on rock masses, and application of timber, metal, concrete, packing, and filling support. R.A.H.

Clay-mining methods and costs at the Carunna (Mich.) pit of the Aetna Portland Cement Co. O. A. DIBBLE. Bur. Mines *Information Circ.*, No. 6657. 6 pp. Free. The report describes the open-pit recovery of clay and gives figures on the cost of removal. R.A.H.

Canadian Mining Manual, 1932. R. C. ROWE. National Business Publications, Ltd., Gardenvale, Quebec, Can. Abstracted in *Can. Mining Met. Bull.*, No. 246, p. 564 (1932). G.M.H.

Book Review

Handbook of Industrial Temperature and Humidity Measurement and Control. M. F. BEHAR. Instruments Publishing Co., Pittsburgh, Pa., 1932. 6 x 9¼ inches. 320 pages. 278 illustrations. Cloth. $4.00. Two separately titled books are here combined into one volume, *i.e.*, "Temperature Measurement and Control" and "Humidity Measurement and Control." These constitute, respectively, Part Two and Part Three of the Manual of Instrumentation which B. undertook several years ago with the purpose of laying the foundation of a modernized form of industrial engineering. The volume really comprises not two but four separate "handbooks," (1) thermometry, (2) pyrometry, (3) automatic control of temperature, and (4) humidity measurement and control, plus two chapters, both pertaining to all four handbooks, and nine appendices of which seven pertain to temperature and two pertain to humidity. The treatment of industrial thermometry devotes little space to laboratory instruments, but takes up in detail industrial mercury-in-glass thermometers, pressure-spring thermometers, and resistance thermometers. The classification of pressure-spring thermometers deals with liquid-expansion types under two separate heads, *i.e.*, "mercury" and "xylene," the latter standing for the nonmercurial liquids. Resistance thermometry is summarized fairly comprehensively. Pyrometry is dealt with under the usual main headings, thermoelectric, radiation, and optical methods, presented in interesting style. The third major subject is temperature control. Despite the fairly voluminous literature on control devices there has never been any treatment of control technology previously published. B. is the first to lay down the principles of correct temperature control. Humidity measurement and control is treated fairly exhaustively, quite completely as far as the engineer, rather than the scientist, is concerned. First comes a nonmathematical chapter on humidity and its industrial importance; then a chapter on humidity measurement which includes a complete set of humidity measurement formulas; then a long and profusely illustrated chapter on measurement methods and instruments; and finally a chapter on control in which are laid down the basic principles to be observed for the attainment of effective automatic regulation. Of the two chapters which pertain to the four major subjects, one is a general discussion of temperature. It opens with the aspect of temperature as an industrial service condition, deals with measurement principles, describes the International Temperature Scale, and classifies industrial temperature instruments. The other general chapter is on temperature recorders. Free from theory, it describes many types, including those brought out in 1932, and discusses the advantages and limitations of all types of mechanical and electrical graphic instruments. The appendices are made up of articles and tables. The former include discussions of thermometric lag, mercurial thermometry, vapor pressure thermometer installations, and checking pyrometer installations. The latter comprise three sets of tables, temperature conversion, thermocouple temperature-millivolt, and humidity tables. This is an outstanding work, possibly the most notable technical book of 1932. W.W.M.

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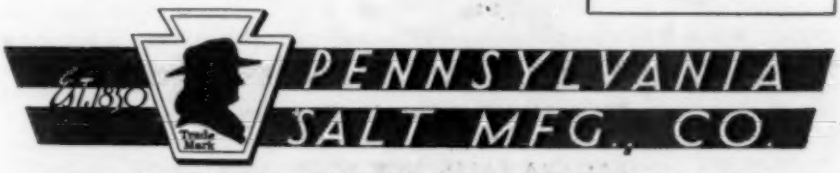

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of the

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A Monthly Publication Devoted to Proceedings of the Society, Discussions of Plant Problems, Discussions of Technical, Scientific, and Art Questions, and Promotion of Coöperative Research

Edited by the Secretary of the Society Assisted by Officers of the Industrial Divisions

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EDITORIALS

PRESIDENTIAL ADDRESS, 1933

By Emerson P. Poste

I. Introduction

Your retiring President is not able to produce a masterful discussion of national and international problems as was done by General Orton at the 33rd Annual Meeting in Cleveland in 1931,[1] nor is he qualified to review the economic situation as was so ably done by Mr. Eskesen at the Washington Meeting the following year.[2] In the present case there is a greater possibility of success in considering certain of the internal affairs of the Society and in suggesting possible means of greater usefulness, with special reference to the attention which these several matters have received during the administration now coming to a close. It is taken for granted that the membership at large is interested in and should be more familiar with the functioning of the Society. If this assumption is correct a statement of the accomplishments and aims of the year is in order.

As stated in an editorial[3] which appeared in December, 1932, "Upon assuming the responsibilities of administering the affairs of the American Ceramic Society the present Officers and Trustees addressed themselves to a two-fold program. The major re-

[1] *Bull. Amer. Ceram. Soc.*, **10** [4], 73 (1931).
[2] *Ibid.*, **11** [4], 77 (1932).
[3] *Ibid.*, **11** [12], 265 (1932).

sponsibility was to conduct the business of the organization so as to operate within the reduced income incidental to the economic situation. The second was to make a study of the affairs of the Society looking to possible improvements of organization and a re-evaluation of responsibilities that might pave the way to greater usefulness in the better days that are to come." Progress which may have been made along these lines falls far short of the good intentions but it may well receive our consideration.

II. Executive Committee

Possibly the most outstanding recent improvement in the machinery of the Society is the Executive Committee instituted by Mr. Eskesen which has now functioned for two years. Formerly the Trustees met at the Annual Meeting and were forced to carry on all interim business by correspondence. The very nature of the case made it impossible for the Officers and Board to be in sufficiently close touch with affairs or to give to the employed staff the advice and help to which they were entitled. As a result it was left to the Secretary to furnish most of the direction and action. The creation of the Executive Committee has served to overcome these weaknesses.

The Executive Committee is composed of the President, Treasurer, and three Trustees and is given "full power to act for the Board of Trustees during the interim of meetings of the Board." It is specified that meetings of the Committee shall be held at least quarterly (Constitution, Article IV, Section 2).

During the year just closing two all-day meetings of the Committee were held at the Columbus office, all members being present. The routine affairs of the Society were given careful attention and several matters of policy were studied.

The Secretary and his staff have cordially welcomed and responded to the suggestions of the Executive Committee, apparently appreciating the help and guidance thus afforded them between Annual Meetings.

III. Finances

The problem which has challenged the major attention of all during the past year is finances. Fortunate is the organization that has been able to trim its expenses to meet its income without major reductions in service rendered. This has been accomplished by the American Ceramic Society during 1932 by careful planning and co-operative execution.

The total expenses of the Society for 1930 were $48,414.62; for 1931, $43,633.56. The budget for 1932 as submitted by the Budget Committee totaled $41,030. In their report they said, "As a further matter of general policy, your Budget Committee recommends that the 1932 budget be adjusted periodically during the year, if necessary, to meet income conditions." The wisdom of the Budget Committee was promptly demonstrated. The financial statements for January and February were unfavorable and the one for March more so. The Secretary called to the attention of the Executive Committee prior to its April meeting the necessity of a budget revision that would make possible the retrieving of the losses of the first quarter and keeping the total 1932 expense within income. The Committee worked out a revised budget on the basis of a full year at $32,800 and it has been very gratifying to see the cumulative monthly statements beginning with May come closer and closer to the revised budget figures, with small monthly profits to off-set the first quarter losses. The total operating expense for 1932 was $33,176.61.

Due to a combination of causes losses have been indicated on several recent years. These have resulted from excessive cost of publications, loss incurred on European tour, rapid writing down of inventory, and other sources. We have possessed liquid securities far in excess of our obligations, but our surplus was being encroached upon. It became

necessary, therefore, to enter each new year with heavy obligations, some of which had to be met with advance dues for the following year. In the immediate past the intensity of this condition has been gradually decreased, our total obligations January 1, 1933, being $5150.66 compared with $12,267.90 as of January 1, 1931. To establish a more favorable cash position, a one thousand dollar Liberty Bond was disposed of this year.

During 1931 the Fellowship funds were not set up as a separate account as specified. To meet this situation $457.09 for 1931 and $697.51 for 1932 were listed as liabilities against the general account.

The books at the close of 1932 show a net gain of $1079.11. Taking into account the $1154.60 set up to the credit of the Fellowship for 1931 and 1932 the gross gain for the year is $2215.36.

The financial condition has received rather detailed explanation because some of the membership are under the impression that the Society habitually operates at a loss and is not gaining ground. This is the second consecutive year that a profit has been made and for the years 1921 to 1930 five years show a profit and five a loss. The present system of financial control, credit for which is largely due to Messrs. Eskesen, McKinley, and Kleymeyer, should make possible a small profit each year if the monthly statements are properly used as the basis for budget adjustments.

IV. Membership

With reduced personal and corporation incomes the order of the day, it is only to be expected that a decrease in membership should follow. The Society has been lenient with members whose ability to pay has been temporarily decreased but, in spite of this, membership losses have come. The Membership Committee has carried on a quiet campaign which has been partially successful. Changes for the year have been

	Loss	Gain	Net Change
Personal	339	44	295 (loss)
Corporation	46	4	42 (loss)

leaving the membership December 31, 1932, Personal 2052 and the Corporation 237.

V. Publications

The publications of the Society have received major attention for therein lay our best source of economy. It is felt that the critical study which has been made has resulted in better publications at a much lower cost. The Division Editorial Committees have functioned to a greater degree than before resulting in more meaty articles of greater technical value. The *Abstracts* have been more critically edited with a saving of space and an advance in quality. Division Abstract Editors are now being arranged for as a means of still greater improvement. The constructive efforts toward bettering our publications are further reflected in the recommendation of the Publication Committee in the January, 1933, *Bulletin*.[4] The Committee and Editorial Staff deserve our appreciation for fine work done under unfavorable circumstances.

VI. Advertising

A corollary of the general economic situation has been a decrease in advertising income. This problem has been approached from two angles, methods of soliciting advertising space and ways of increasing advertising value of our publications. A special committee, appointed at the beginning of the year, has given this careful study and its recommendations are now being reviewed by the Publication Committee.

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[4] *Bull. Amer. Ceram. Soc.*, **12** [1], 26 (1933).

VII. Sections and Divisions

Local Sections and Student Branches are very important phases of an organization such as ours. Unfortunately our financial ability has not made it possible to devote the personal attention that the situation calls for. But it is probable that too little thought has been devoted to these important units, financial status taken into account. It has been the privilege of your President to visit but one Local Section and one Student Branch. The enthusiastic reception and great manifestation of interest in these two instances, however, strongly indicate the merit of a greater effort on the part of our Society along these lines.

VIII. Research

How best to foster and coördinate research is one of the outstanding problems confronting the Society today. Each Division has its Research Committee. In some cases there seems to be no activity. At the other extreme, Division Research Committees are actually administering funds for the execution of problems which have been assigned by the Divisions. The present general Committee was asked to make a thorough study of this entire field and they have gone at their work seriously. The results of these efforts led to planning a general session at the 1933 Annual Meeting devoted to the subject of Coördinated Research. No more potentially important feature than this can be listed among the accomplishments of the year.

IX. Education

Probably at no time in our national history has our educational system at large been subject to a more searching criticism than during these days of stress. Are our schools and colleges affording the opportunities needed to enable our youth best to fit themselves for their place in our social and economic system? Are students receiving proper character development to give them the sound foundation essential to all lines of endeavor? Are they obtaining a proper cultural background to make possible a full enjoyment of the finer things of life? More specifically, are our technical and engineering schools properly training our young men in the fundamentals of science and engineering or are they trying to crowd in too much of the more definitely practical courses at the expense of the basic studies so essential to any form of applied endeavor? And finally, are our youth receiving that type of vocational guidance that keeps the "square plug out of the round hole?" These are some of the many questions of the day. How can the American Ceramic Society be of service in approaching a solution of these problems from the point of view of the ceramic industries? There would seem to be a great opportunity. Our Committee on Education can well serve as a clearing house between the industry and our ceramic schools.

There are many indications that an encouraging tendency exists. In the files of the Society for the current year are many letters expressing views on this problem, and discussions with educators and men of industry indicate a desire for a constructive cooperative effort. The Education Committee of our Society is quietly at work. The membership of this Committee should have a reasonable degree of continuity. It should foster symposia in which representatives of industry and educational institutions can frankly discuss their mutual problems. Both sides should eagerly assume an attitude of open-mindedness. Surely no problem deserves more careful study than the education of our youth.

X. The Fellowship

No new organization can be expected to burst into full bloom instantly. Careful husbandry is essential to the successful development of any new species. The Fellowship was created to fill a need. Early experience suggested the necessity of certain changes in detail, many of which have had the careful study of our Rules Committee and revisions are being presented for approval. Others are still to be developed.

Meantime certain other steps have been taken. The Fellowship dues, in excess of the expense, properly charged to the operation of the organization, stand as a separate fund available to the Fellowship. Most appropriately the first activity is the establishment of the Orton Lectureship in memory of the founder of the Society and the Fellowship and certainly in no finer way could the founder be honored or the Fellowship serve than to make possible at each Annual Meeting a lecture of outstanding type which might not otherwise be within the reach of the Society.

That the Fellowship may mature to realize its purpose and be a potent agency in the affairs of the American Ceramic Society is the prayer of the closing administration.

XI. Functions of the Society

There is probably no more vexing or important problem before the American Ceramic Society today than that of its proper functions with reference to the several lines of interest which it is attempting to satisfy. This situation must be faced and carefully worked out if the Society is to be of maximum service to its membership and to the ceramic industries.

The complexity of the interests represented by the membership as a whole renders it no easy task to determine satisfactorily the proper course to follow. Many of our members are, by vocation, chiefly interested in theoretical or academic matters while, at the other extreme, are those whose work is of the strictly practical type. Between are all classes of individuals including those whose duties are administrative and therefore must have to do with both of the other points of view. Again, some of the Divisions are constituted, in the main, of technical men and the activities are of a definitely scientific nature. Other Divisions have made a positive effort to gain the interest and support of plant men and to plan their affairs so as to offer corresponding values.

That we are a "technical" society has been repeatedly affirmed. The existing problem arises in the interpretation of the term "technical" as regards the functions of an organization so labeled. An effort to present the elements of the case took the form of an editorial in the December, 1932, *Bulletin*[5] which has been elsewhere referred to. We shall not repeat other than to state that there were presented three groups of activity for trade and technical organizations as a whole. In one group fall those functions which are agreed upon as the prerogatives of the trade association while at the other extreme are functions definitely belonging to the technical society. The third grouping contains a list of items of overlapping interest. The allocation of specific activities to this as compared with one of the other groups permits of difference of opinion.

In our efforts to analyze our own particular situation and chart our course we may well endeavor to promote a clearer understanding among ourselves and to make sure that we are understood by others. We must develop in our own minds an appreciation of the responsibility of a technical society to the industries involved and our proper relation to the trade associations into which they are organized. In this we should not ignore the experience of other groups. Quoting one well versed regarding such tendencies, "In a large number of industries there has been developed a very close relationship between the technical societies and the trade associations.... In some of the ... industries the technical societies are members of a joint council or are a part of a general organization representing all the divisions of the industry." Extremes may well be avoided. We should certainly not so abandon our academic activities and transgress the functions of the trade associations as to lose our standing as a technical society. Nor should we so far remove ourselves from the practical side of our activities as to forfeit our immediate usefulness and appeal to the industries which we endeavor to serve.

[5] See footnote 3.

The differences of opinion as to our status with respect to these points indicate the necessity of a more definite statement of policy. It is urged that we do all we can to formulate and promote a clear understanding of our legitimate activities on the part of our own membership and by our several ceramic trade associations.

During the year, as in the past, much thought has necessarily been given to this situation as a whole. The Society has been approached with reference to sponsoring or endorsing certain movements which have so evidently been the function of trade organizations that they have been rejected. As brought out under the several headings above, active work has been done on a number of problems specifically falling to the technical society. We have frequently been called upon to furnish information of a purely technical or scientific nature. Requests have involved tests of raw materials and finished products, methods of processing, and the like. References to the literature and to our standing committees have frequently served the needs involved. We have also been invited to send representatives to various conferences and bodies, and we have met these requests to the best of our ability. In addition, the Officers and Trustees of the Society have endeavored to act wisely with regard to several projects which fall in the "disputed" class.

More clearly to indicate the types of problems which are certain to challenge us from time to time we may well consider some of those which have received our attention this year.

Two instances having to do with quality of product are worthy of mention. In one case a ceramic commodity as a whole has had unfavorable criticism because of certain field failures. Some of these were no doubt due to inferior quality, others to faulty use. The prejudice arising, however, has not been based on any such differentiation but has reacted unfavorably in both cases alike. The other instance had to do with placing the responsibility for damage in transit, whether due to rough handling, improper packing, or defective quality. Some have felt problems of this type to be entirely outside the functions of our Society. Should not the manufacturer study the quality of his product and the uses thereof so as to know whether trouble of these and similar types is due to faulty material, rough handling, or improper use, and if necessary, improve his product accordingly? If so, should the individual manufacturers do this entirely independently or should at least some phases of it be done collectively? How should transportation agencies and users become informed of the fundamental facts regarding ceramic products? Who should supply the information, who best can formulate and present it? Has the American Ceramic Society a duty and a service to perform in aiding to secure and make available for the welfare and protection of the manufacturer information of this type which goes back to the basic consideration of quality of product in terms of its use? These are some of the questions to which we are forced to address ourselves. No official action has been taken with regard to policies in these instances.

The foregoing suggests one phase of a problem which goes back to a more fundamental matter, that of coördinated research, not only in terms of quality of final product but all of the elements entering into its manufacture. What relations should exist between producers, college and government laboratories, trade associations, and the American Ceramic Society? As previously stated, the importance of this question has so appealed to the Officers and Committees as to result in a general session on Coöperative Research at the 1933 Annual Meeting.

Some agency should devote attention to making the public more familiar with and informed about ceramic products as compared with competitive materials. If one doubts the need of efforts along this line let him go into a store and question a clerk about the terms "porcelain," "vitreous enamel," and "lacquer," or "Japan." Or let him discuss with the average architect the properties and uses of ceramic building

materials. Your Officers and Board of Trustees have felt strongly enough on this point to go on record in the form of a resolution.[6] Were they wrong in so doing? They wondered how generally their action would meet with approval. Hence a questionnaire to 154 present and former Society and Division Officers which brought in 137 replies. Of these, 133 were favorable, many of them most enthusiastically so. A few qualified their favorable replies and only 4 registered disapproval.

A further step away from purely scientific matters has to do with bringing about an accurate appreciation on the part of the American buyer of the relative merits of certain domestic and foreign goods. How far should the Society go to motivate a campaign in this direction? The injection of the "Buy and Sell American" idea into the plans for the Pittsburgh Meeting seems to have met with cordial approval. No systematic effort to canvass opinion has been made.

The final case bearing on this wide problem of functions of the Society has to do with the exposition or show. Should it be sponsored by the Society, trade association, or both? In several instances the Society has so functioned with varying degrees of success. Many of the efforts have been definitely encouraging in terms of interest and financial return. That something is lacking in this field, however, is evidenced by the repeated failure of tentative plans for adequate coördinated representation at the Century of Progress. Is the Society in error in trying to be of service along these lines? Is the fundamental principle wrong or are there certain details which stand in the way of satisfactory accomplishment?

If the Society is to function in these and other phases of ceramic product promotion it has a right to expect the hearty financial support of the benefited manufacturers through corporation memberships. Those technologists whose interests are more academic should not have cause to feel that their personal membership dues are being used along lines of minor interest from their point of view.

Those who are to administer our affairs in the future have a grave responsibility as they face these problems. But it does not rest alone with your officials. It is, or should be, a matter of vital concern to every individual member and to the ceramic industries at large. Let every one devote his thought to the situation and make his unprejudiced conclusions available to those who are charged with the duties of forming and executing policies.

XII. Recommendations

Perhaps one who has devoted a considerable part of his time to the work of the Society for a year may be permitted to make a few criticisms of the present set-up.

The outstanding weakness seems to come from lack of continuity of program and policy, largely through frequent turnover of responsible personnel. With a new president coming into office, particularly if he has not had previous experience on the Board, much time is lost in perfecting a new organization and establishing policies and programs for the year's work, unless he somewhat weakly accepts, without careful study, the product of the minds of others. The Secretary is, of course, familiar with past history. But the new president, vice-president, and those trustees just entering their terms of office, if they take their responsibilities seriously, will need some time to "get their feet on the ground," before becoming sufficiently familiar with affairs personally to endorse or improve policies which may have come from previous administrations or, perhaps, from the program of the Secretary. It may be safely said that nearly a half-year is largely wasted in "getting up steam." For these new officers immediately to fall in line with the policies presented to them by the Secretary and "carry-over" Board members

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[6] *Bull. Amer. Ceram. Soc.*, **11** [11], 254 (1932).

may be construed as weakness on their part or an effort for the Secretary to dominate the affairs of the Society.

Furthermore, the new president naturally requires some time in making his committee and other appointments for the approval of the Board. He may not be familiar with the work of past committees and may have to acquire judgment as to which chairmen to continue and which ones to replace. If there is to be reasonable continuity and progress the personnel of many of the committees should not be radically changed every year. Granted that many of the individual committee members are by Division selection, the general chairmen in all cases are chosen by the Board and to these chairmen the Society must largely look for policy and initiative. These ideas operating in the extreme might give rise to a somewhat narrow group with too much control. Judgment should be used to avoid such an objection.

It is the personal opinion of your retiring president that it is unfair to the man and to the Society to elect a president who has not had experience on the Board. On the other hand, it is not advocated that the president should necessarily be chosen from those who have previously come to the Board as Trustees. But two alternatives suggest themselves, namely, electing the vice-president with the understanding that he is to be promoted to the presidency and that his term as vice-president is in preparation therefor; or electing the president a year in advance and having him serve on the Board as president-elect. The latter plan works well in at least one other technical society and is the one hereby favored. This plan would promote advance familiarity with the affairs, plans, and policies of the Society, and would make possible the setting-up of a full working organization at the very beginning of the new term of office.

If we as a Society are to solve the problems that confront us, and they are many, and take our rightful place in relation to the ceramic industries, our own membership, and other technical societies, we must study our case without personal prejudice, modify our methods to meet the demands placed upon us, and develop a policy of continuous and concerted activity which will allow us to approach our possibilities.

As his last official statement your President wishes to acknowledge the hearty support of the Officers and Trustees, particularly the Executive Committee, and the general committee chairmen, especially the Publications, Rules, and Research Committees, for their splendid work. He has a personal word of praise for the Secretary-Editor and his staff for the fine manner in which they have met a difficult situation. And most of all he wishes to thank the membership at large for the opportunity which they have afforded him in serving them as their President. Let us hope that these coöperative efforts may have resulted in some progress and that they may have helped to build the foundation for greater accomplishments.

A PROPHECY THAT FAILED*

By W. D. Richardson

In the Science News Letter of Dec. 10, there is an account of the celebration by the French Academy of Medicine of the centenary of one of its living members, Dr. Alexander Gueniot, eminent obstetrician, surgeon, and author, and former president of the academy. It is reported that Dr. Gueniot was an erect, alert figure; smiling attentively at the kindly speeches which one distinguished orator after another delivered. They all read their carefully prepared addresses. But when it came turn for Dr. Gueniot to reply, he jumped up lightly from his chair and delivered the opening sentences of his speech without any reference to his manuscript. Afterward, he sat down and read a

* *Columbus Journal-Dispatch*, December, 1932.

short paper, "the whimsical wit of which made this assembly of the most eminent savants of France rock with laughter."

I am bringing this to your attention chiefly to present in these times of perplexing problems in our country, a letter that was written by Dr. Gueniot's father, in 1832, to an intimate friend.

"I do not know whether to be happy or sorry over the birth of a son, to which I have contributed only a modest share. The poor infant enters the world in very troubled times. Hardly seventeen years have passed since peace was restored to Europe, and we still suffer from the effects of the war. Who knows if my son will not one day become the citizen of a republic? It makes one shudder. The conditions of life are daily becoming more difficult. Nanette, our servant, has paid 23 sous for half a kilo of butter, and 2 sous for each fresh egg! It is absurd and exorbitant!

"I would like to see my son embracing the noble career of medicine, but I see quite well that he can not; one of the heads of the faculty has confided to me that this profession is literally invaded. And then, this madness of speed is wearing out men. Only yesterday I saw a post chaise tearing along. It made one giddy! The horses were galloping at more than five leagues an hour. And everyone wants his carriage! The streets of Paris are so congested that you must wait a long time if you wish to cross them. Madness of the century, my dear friend, for which men will pay in the brevity of their days.

"My son, like his contemporaries, will not live to be old. We know not what the future has in store for him, but we can bet with certainty on his not becoming a centenarian."

ACTIVITIES OF THE SOCIETY

BUY AMERICAN

DRAMATIC EXHIBITS IN PITTSBURGH, WEEK OF FEBRUARY 12

The American Ceramic Society is keenly interested in keeping our factory fires burning. For this reason this Society is aiding two distinct, yet related movements.

(1) Making Americans "ceramically conscious," that is, conscious of the fact that for the several household uses, for building, for paving, for sanitary purposes, and many others, ceramic wares are superior. American-made ceramic wares are equal to and in most instances are superior to any made abroad.

JUDGE M. A. MUSMANNO

(2) "BUY AMERICAN," an economic recovery measure. If we are to have an economic recovery in America and abroad, our American Industries must be protected from the flood of imported wares that are made by low wage labor, and valued for tariff purposes on the basis of debased currency.

America can not maintain her standard of wages and her widespread enjoyment of cultural pursuits unless Americans buy American-made ware. Tariff, no matter how high, can not offset the wage and currency differentials which today are impoverishing Americans and socially debasing European countries.

"BUY AMERICAN" will help America to economic recovery; it will aid the world! "BUY AMERICAN" is patriotic; it will react favorably abroad.

The ceramic trade associations are cooperating in this dual program of (1) making Americans ceramically conscious, and (2) "BUY AMERICAN." During the week of February 12, they will have dramatic exhibits in the stores of Pittsburgh.

On the afternoon of Thursday, February 16, at two o'clock, in the Urban Room of the Hotel William Penn, there will be a fact recital and pep meeting. The speakers will be as follows:

Victor V. Kelsey, *Chairman.*
(1) C. S. Clark, *National Executive Secretary, Made-in-America Club,* Chicago, Ill.
(2) L. D. Odhner, *General Manager, Buy American Association,* Philadelphia, Pa.
(3) Judge M. A. Musmanno, Pittsburgh, Pa.
(4) George E. Stookey, *Executive Secretary, The American Patriotic League,* Wilkes-Barre, Pa.

You are invited to attend the meetings of the American Ceramic Society all week beginning February 12, at the Hotel William Penn.

JOHN CLYDE HOSTETTER

The Nominee for President

BORN: Williamsport, Pennsylvania, 1886.
EDUCATION: Bucknell University, B.Sc. in Chemistry (*in absentia*) 1908, M.Sc. in Chemistry 1909, Ch.E. 1930; University of Chicago, 1908.

POSITIONS: Bucknell University, Instructor in Chemistry, 1908–10; Bureau of Standards, Assistant Chemist, 1910–12; Geophysical Laboratory, Carnegie Institution of Washington, Assistant Physicist and later Physical Chemist, 1912–19; War work, manufacture of optical glass, Section of Optical Glass Production, War Industries Board; Corning Glass Works, Steuben Division, 1919–21, Manager, 1920–21; Assistant to Vice-President in charge of manufacturing, 1921–23; Manager Rhode Island Division, 1924–28; Manager Bulb and Tubing Production (Corning), 1928–30; Director Development and Research, 1930.

CLUBS: Cosmos, Washington, D. C.; Chemists, New York, N. Y.; Corning City, Corning Country, Corning, N. Y.

SOCIETIES: American Ceramic Society, Fellow, Chairman Glass Division 1922–23, Trustee 1924–28; American Chemical Society, Chairman Rhode Island Division 1925; Society of Glass Technology; Deutschen Glastechischen Gesellschaft; Washington Academy of Sciences; American Institute of Chemical Engineers; Royal Society of Arts, Fellow.

JOHN CLYDE HOSTETTER

Publications

(1) Possible Movements and Forms in a System of Four Dimensions. Chapter XX. The Fourth Dimension Simply Explained. 1910.

(2) The Reduction of Vanadic Acid in Concentrated Sulfuric Acid Solution by Hydrogen Peroxide and by Persulfates (with J. R. Cain), *Jour. Amer. Chem. Soc.*, **34**, 274–76 (1912).

(3) Rapid Method for the Determination of Vanadium in Steels, Ores, etc., Based on Its Quantitative Inclusion by the Phosphomolybdate Precipitate (with J. R. Cain), Bur. Stand. *Tech. Paper*, No. 8 (1911); *Jour. Ind. Eng. Chem.*, **4** (1912).

(4) The Electrolytic Reduction of Iron for Analysis, *Jour. Wash. Acad. Sci.*, **3**, 429–32 (1913).

(5) A Method for the Determination of Magnesium in Calcium Salts, *Jour. Ind. Eng. Chem.*, **6**, 392–96 (1914).

(6) The Determination of Mineral and Rock Densities at High Temperatures (with A. L. Day and R. B. Sosman), *Amer. Jour. Sci.*, **37** (Jan., 1914).

(7) Vacuum Furnace for the Measurement of Small Dissociation Pressures (with R. B. Sosman), *Jour. Wash Acad. Sci.*, **5**, 277–85 (1915).

(8) Ein Vakuumofen sur messung Kleiner Dissoziationsdrucke (with R. B. Sosman), *Z. Elektrochem.*, **21**, 495–98 (1915).

(9) The Reduction of Iron Oxides by Platinum, with a Note on the Magnetic Susceptibility of Iron-Bearing Platinum (with R. B. Sosman), *Jour. Wash. Acad. Sci.*, **5**, 293–303 (1915).

(10) The Dissociation of Calcium Carbonate below 500°C (with R. B. Sosman and H. E. Merwin), *ibid.*, **5**, 563–69 (1915).

(11) The Oxides of Iron. I. Solid Solution in the System Fe_2O_3–Fe_3O_4 (with R. B. Sosman), *Jour. Amer. Chem. Soc.*, **38**, 807–33 (1916).

(12) The Dissociation of Ferric Oxide in Air (with R. B. Sosman), *ibid.*, **38**, 1188–98 (1916).

(13) The Thermodynamic Reversibility of the Equilibrium Relations between a Strained Solid and Its Liquid (with F. E. Wright), *Jour. Wash. Acad. Sci.*, **7**, 405–17 (1917).

(14) A Silica-Glass Mercury Still (with R. B. Sosman), *Jour. Wash. Acad. Sci.*, **8**, 11–15 (1918).

(15) The Ferrous Iron Content and Magnetic Susceptibility of Some Artificial and Natural Oxides of Iron (with R. B. Sosman), *Bull. Amer. Inst. Mining Eng.*, pp. 907–31 (1917).

(16) Zonal Growth in Hematite and Its Bearing on the Origin of Certain Iron Ores (with R. B. Sosman), *ibid.*, pp. 933–42 (1917).

(17) An Apparatus for Growing Crystals under Controlled Conditions, *Jour. Wash. Acad. Sci.*, **9**, 85–94 (1919).

(18) The Volatilization of Iron from Optical Glass Pots by Chlorine at High Temperatures (with H. S. Roberts and J. B. Ferguson), *Jour. Amer. Ceram. Soc.*, **2**, 356–72 (1919).

(19) The Rapid Electrometric Determination of Iron in Some Optical Glasses (with J. B. Ferguson), *ibid.*, **2**, 608–21 (1919).

(20) Electrometric Titrations, with Special Reference to the Determination of Ferrous and Ferric Iron (with H. S. Roberts), *Jour. Amer. Chem. Soc.*, **41**, 1337–57 (1919).

(21) The Hydrochloric Acid Color Method for Determining Iron, *ibid.*, **41**, 1531–43 (1919).

(22) Hematite and Rutile Formed by the Action of Chlorine at High Temperatures (with H. E. Merwin), *Amer. Mineralogist*, **4**, 121–23 (1919).

(23) The Manufacture and Uses of Rolled Optical Glass (with H. S. Roberts), *Jour. Amer. Ceram. Soc.*, **3**, 750–61 (1920).

(24) Note on the Dissociation of Ferric Oxide Dissolved in Glass and Its Relation to the Color of Iron-Bearing Glasses (with H. S. Roberts), *ibid.*, **4**, 927–38 (1921).

(25) The Co-Precipitation of Vanadic Acid with Ammonium Phosphomolybdate (with J. R. Cain), *Jour. Amer. Chem. Soc.*, **43**, 2552–62 (1921).

(26) Glass, Its Manufacture and Development for Railroad and Other Uses, *Proc. Central Railway Club of Buffalo*, **38**, 3213–22 (1930).

BALANCE SHEET OF THE AMERICAN CERAMIC SOCIETY

Statement of Assets and Liabilities

December 31, 1932

Assets			
Cash in Banks (General Account)		$ 3,667.71	
Revolving Fund		300.00	
Petty Cash		5.00	$ 3,972.71
Liberty Bonds (par $8,700)		8,838.50	
Treasury Bonds (par $400)		409.16	
Savings Account		1,031.78	10,279.44
Accounts Receivable			887.76
Inventories: *Journals* 1923–32		1,121.00	
Enamel Bibliography		132.50	
Transactions		424.00	1,677.50
Office Equipment (less depreciation)			1,916.96
Deferred Charge			
Advance Expenses on 1933 Annual Meeting			88.16
TOTAL ASSETS			18,822.53
Liabilities			
Accounts Payable:	December Printing	2,286.89	
	American Refractories Institute	170.98	
	Abstracting Fees below $10	85.47	
		2,543.34	

1931 Fellow Account	$ 457.09		
1932 Fellow Account	679.16		
1933 Prepaid Fellow Account	270.00	1,406.25	
Deferred Income, Prepaid 1933 Items			
Dues, Corporation	1,744.23		
Dues, Personal	4,259.80		
Divisions	576.00		
	6,580.03		
1933 Journals (subscriptions)	976.47	7,556.50	
TOTAL LIABILITIES AND DEFERRED INCOME			11,506.09
SURPLUS December 31, 1932			$ 7,316.44

Income and Expense Statement

1932

Income			
Dues Earned: Corporation		$ 4,672.91	
Personal		14,953.89	
Divisions		1,501.73	$21,128.53
Journals (1918–31) Sales	$ 424.43		
Cost of Sales and Inventory Cut-Offs	314.34	110.09	
Journals (1932)		4,401.20	4,511.29
Advertising (net)		7,929.78	
Miscellaneous Publications		181.11	
Interest Earned		505.01	8,615.90
TOTAL INCOME			34,255.72
Expenses			
Cost of Publication	13,739.50		
Less 1932 Inventory	168.70	13,570.80	
Abstracts		1,331.39	
Reprints		126.26	
Editor's Office Expense:			
Drawings and Tracings	951.26		
Incidentals	193.65	1,144.91	
		16,173.36	
Salaries	12,313.25		
Secretary's Office Expense	1,052.71		
President's Office Expense	31.16		
Office Rental	970.00		
Postage	982.24		
Traveling	204.23		
Annual Meeting	873.24		
Miscellaneous	227.44		
N. B. M. R. F.	7.00		
Depreciation on Office Equipment	213.00		
Bad Accounts Charged Off	128.98	17,003.25	
TOTAL EXPENSES			33,176.61
INCOME OVER EXPENSES TO DECEMBER 31, 1932			1,079.11

Surplus Account		
Balance January 1, 1932		6,828.40
1931 Fellow Account changed to Liability	457.09	
Balance Due A. R. I. on 1931 Memberships	170.98	
1929 Curtis Survey Fund Closed Out	(37.00)	591.07
ADJUSTED BALANCE AS OF JANUARY 1, 1932		6,237.33
Income over Expenses to December 31, 1932		1,079.11
BALANCE DECEMBER 31, 1932		$ 7,316.44

Comparative Statement of Income and Expenses

1932

	1931		1932	
Income	**Adjusted**	**1932**	**Publication**	**General**
Dues, Corporation	$ 5,650.28	$ 4,672.91	$ 1,260.00	$ 3,412.91
Dues, Personal	17,973.84	14,953.89	7,350.00	7,603.89
American Refractories Inst.	1,355.86			
Divisions (net)	1,292.38	1,501.73		1,501.73
	26,272.36	21,128.53	8,610.00	12,518.53
Journals (current year)	4,382.04	4,401.20	4,401.20	
Journals (previous years)	286.92	110.09	110.09	
	4,668.96	4,511.29	4,511.29	
Advertising (net)	10,856.37	7,929.78	7,929.78	
Miscellaneous Publications	18.49	181.11	181.11	
Contributions	2,035.00			
Annual Meeting	666.90			
Interest Earned	565.44	505.01		505.01
	14,142.20	8,615.90	8,110.89	505.01
TOTAL INCOME	45,083.52	34,255.72	21,232.18	13,023.54
Expenses				
Cost of Publication	19,658.53	13,570.80	13,570.80	
Abstracts	1,926.90	1,331.39	1,331.39	
Reprints (net)	765.75	126.26	126.26	
Editor's Office Expense	1,270.92	1,144.91	1,144.91	
	23,622.10	16,173.36	16,173.36	
Salaries	13,905.00	12,313.25	7,056.00	5,257.25
Secretary's Office Expense	1,727.64	1,052.71		1,052.71
President's Office Expense		31.16		31.16
Postage	1,352.45	982.24	410.00	572.24
Office Rental	1,080.00	970.00	485.00	485.00
Traveling	506.87	204.23		204.23
Annual Meeting		873.24		873.24
Committee	10.32			
Miscellaneous		227.44		227.44
Century of Progress	554.43			
N. B. M. R. F.		7.00		7.00
Depreciation	227.36	213.00	106.50	106.50
Bad Accounts Charged Off	194.80	128.98	128.98	
Inventory Charged Off	452.59			
	20,011.46	17,003.25	8,186.48	8,816.77
TOTAL EXPENSES	43,633.56	33,176.61	24,359.84	8,816.77
Gain or (loss)	$ 1,449.96	$ 1,079.11	($ 3,127.66)	$ 4,206.77

CHARLES FERGUS BINNS MEDAL

The Charles Fergus Binns Medal for excellence in ceramic art has been awarded for the year 1932 to Adolph Fritz Hottinger. Mr. Hottinger is Vice-President-Treasurer and Technical Adviser for the Northwestern Terra Cotta Company.

LOCAL SECTION NEWS

Baltimore-Washington Section

Thirty-nine members were present at the dinner and meeting of the Baltimore-Washington Section, December 3, 1932. Illustrated lectures were given by Dr. G. E. F. Lundell and Dr. F. C. Kracek.

Pittsburgh Section

A meeting of the Pittsburgh Section was held at Mellon Institute, January 10, 1933. Donald Ross of the Findlay Clay Products Co. talked on "Tank Blocks."

NECROLOGY

L. E. Jeffery

In the January *Bulletin* there was a notice of the death of L. E. Jeffery, son of Dr. J. A. Jeffery. We are pleased to reproduce his photograph.

Those who attended the Summer Meeting in Detroit or the Annual Meeting there in 1927 will remember the untiring and efficient service which Lester rendered as one of the hosts.

The members of the American Ceramic Society have lost a valued friend and co-worker in L. E. Jeffery.

L. E. JEFFERY

Robert F. Segsworth

Robert F. Segsworth, barrister, died at his home in Toronto recently. He was born at Toronto, Feb. 8, 1867, and was educated at the Toronto Model School and Jarvis Collegiate Institute.

Mr. Segsworth was actively interested in mining and had a wide acquaintance among mining men. He had been Secretary-Treasurer of the Seneca Superior Silver Mines, Ltd., and was a director of Dome Mines, Ltd., at South Porcupine. He also took part in the development of the Richardson Feldspar Mine near Kingston.

He was a member of the American Ceramic Society for several years. He was one of our hosts at the two summer meeting tours and in 1930 when our Annual Meeting was held in Toronto. We shall miss Bob.

Edmund D. Otstot

Word has been received of the death of Edmund D. Otstot of New Straitsville, Ohio, plant manager of the Ironclay Brick Company at Shawnee, Ohio.

After studying mining engineering at Ohio State University, he became associated with the Hocking Valley Products Company. Later he did considerable mineral prospecting in the West and in Mexico after which he again assumed his duties as mining engineer with the Hocking Valley Products Company.

A staunch supporter of the American Ceramic Society and other collective activities, Ed Otstot was well known. His pleasing personality and his friendliness gave him a wide acquaintance. He will be missed.

E. D. Otstot

NOTES AND NEWS

NEW DIRECTOR OF BUREAU OF STANDARDS

Recognized as one of the leading physicists in the world, Lyman Briggs has been appointed director of the Bureau of Standards by President Hoover. Dr. Briggs, who has been connected with the Bureau since 1930, succeeds the late Dr. George K. Burgess.

Lyman Briggs

NELSON W. TAYLOR APPOINTED PROFESSOR OF CERAMICS AT PENNSYLVANIA STATE COLLEGE

Dr. Taylor's appointment became effective January 1, 1933. He was graduated from the University of Saskatchewan in 1919 with a Bachelor of Science degree in chemistry. He received his Master of Science degree in chemical engineering in 1920 from the University of California and his doctorate in physical chemistry in 1923 from the same university. He was a member of the faculty, Department of Chemistry, University of California, from 1923 to 1925, and Division of Physical Chemistry, University of Minnesota, 1925 to 1932 except during 1929 to 1930 when he was a Guggenheim Fellow in geochemistry at Berlin and Göttingen. He has established himself as a teacher-scientist and a pioneer investigator, especially in the field of petrography and silicate chemistry.

In his undergraduate days, Dr. Taylor made many chemical analyses of silicate rocks and in his graduate years he had considerable experience in high-temperature measurements. He took his optical work on silicates with F. F. Grout of Minnesota and has had experience in crystal structure investigations by means of X-rays. While in Berlin he worked at the Kaiser Wilhelm Institut für Silikatforschung, a laboratory devoted primarily to silicate investigations. This laboratory is under the leadership of Professor Wilhelm Eitel.

Dr. Taylor translated Professor Eitel's book, Grundlagen der physikalische-chemischen Petrographie, but the work was never published on account of the current business depression.

While in Göttingen, Dr. Taylor prepared a number of silicates and titanates by reaction between the component oxides at high temperatures in the solid state without fusion. The structures of the products were determined by X-ray analysis. This line of attack (solid phase reactions) has great possibilities in the development of high-grade refractories. Dr. Taylor has invented a small X-ray camera which is particularly useful for rapid work and for orientation work at high temperatures.

Dr. Taylor also took work in mineralogy (polished opaque specimens) with Dr. G. M. Schwartz of Minnesota and work in crystal structures with Dr. J. W. Gruner of Minne-

sota and Dr. V. M. Goldschmidt of Göttingen. He worked two summers as a petrographer with the Mayo Foundation, Rochester, Minnesota, and two summers with the U. S. Bureau of Mines and the University of Utah, Salt Lake City, Utah. He has published twenty-seven scholarly papers on scientific and technical subjects.

J. E. LEWIS HONORED

At a meeting held December 12, 1932, J. E. Lewis, President of Harbison-Walker Refractories Co., Pittsburgh, was elected President of the American Refractories Institute.

STANDARD CLASSIFICATION OF FELDSPAR

By B. C. Burgess*

When the Classification for Feldspar (CS23–30) was drawn up it was realized that there might be points which would need revision from time to time, so provision was made for annual meetings to consider recommendations for revision. A majority of the consumers and producers of feldspar accepted this standard when it became effective on September 1, 1930.

There seems, however, to be some need for a clearer understanding of the classification. The following questions have come up:

(*a*) It is assumed that the standard would destroy existing or established grades.

(*b*) Many have the impression that the classification is a set of grades standardized by feldspar producers which would eliminate individual consumer's specifications.

(*c*) The physical classification based on the designated mesh and 200-mesh has been considered inadequate by some consumers.

(*d*) The need for a fusion specification has been suggested.

These points are explained as follows:

(*a*) The commercial standard does not interfere with existing grades. Chemically its scope covers the full range of particle sizes in general use in the ceramic industry. It is expected to effect an adequate and comprehensive means of classifying the existing grades according to the SiO_2 content and the ratio between alkalis.

(*b*) Individual consumer's specifications are in most cases a help to the feldspar producers and all of them welcome individual specifications from their customers and adhere to them as far as possible. These specifications, however, can be classified according to the commercial standard grades though the commercial standard grade may be wider than the individual specification. The individual specification then serves as a supplement to the standard.

(*c*) The physical classification according to particle size is a remarkably close specification in regard to grinding. It represents limits, however, which are commercially practical to maintain on all types of grinding equipment now in use for grinding feldspar. At the time the standard was drawn up it was realized that additional grain sizes might be needed to complete the physical classification. To determine the extent of this classification a large number of sieve analyses of feldspar ground and classified in different types of equipment were plotted, and the relation at 200-mesh was shown to be maintained on the finer meshes down to 325-mesh. In consideration of these data the Committee decided to allow the original size classification to stand rather than to complicate the standard by specifying limits on finer sieves.

Use of the Commercial Standard for Feldspar has a number of advantages over any other means of classification now in use. Some of the advantages that may be mentioned are as follows:

(1) Silica content is a major factor in controlling the shrinkage and thermal expansion of a ceramic body. Specification of silica content is of great assistance along this line.

* Chairman, Standing Committee on Commercial Standard for Feldspar, CS23–30.

(2) Fusion point is primarily a factor of the ratio between the alkalis; this is one of the fundamentals of the Commercial Standard.
(3) Certification that the material is of the specified grade under the standard is an excellent assurance to the user.
(4) Standardization of particle size simplifies calibration of classification equipment and allows the producer to furnish more uniform grades, thereby causing the consumer less trouble from nonuniformity of size.
(5) The consumer has a direct comparison of prices.
(6) The comparison of quality is simplified.
(7) The standardization allows the producer to give better values, more uniform quality, and better service.

The questions raised during the first year and a half of the operation of the Commercial Standard, CS23–30, are those outlined above. The Committee will welcome suggestions concerning the standard and will be glad to offer explanation of any points which are not clearly understood. Those not having copies of the standard may obtain them from the Superintendent of Documents, Government Printing Office, Washington, D. C., for five cents per copy.

The Standards Committee of the American Ceramic Society has requested that feldspar be included in the 1933 report of the Committee.

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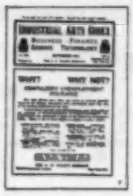

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